A Dissertation on

A COMPARATIVE STUDYBETWEEN MODIFIED UNDERLAY MYRINGOPLASTY WITH GRAFT OVER THE HANDLE OF MALLEUS AND CLASSICAL UNDERLAY TECHNIQUE WITH GRAFT UNDER THE HANDLE OF MALLEUS

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DECLARATION

I, **Dr.V.A.KARTHIKEYAN**, Solemnly declare that the dissertation, titled **"A COMPARATIVE STUDY BETWEEN MODIFIED UNDERLAY MYRINGOPLASTYWITH GRAFT OVER THE HANDLE OF MALLEUS AND CLASSICAL UNDERLAY TECHNIQUE WITH GRAFT UNDER THE HANDLE OF MALLEUS"**is a bonafide work done by me during the period from FEB 2011 to SEP 2012 at Government Stanley Medical College and Hospital, Chennai under the expert supervision of **PROF.DR.T. BALASUBRAMANIAN, M.S., D.L.O.,** Professor and Head, Department Of Otorhinolaryngology, Government Stanley Medical College and Hospital, Chennai.

This dissertation is submitted to The Tamil Nadu Dr. M.G.R. Medical University in partial fulfilment of the rules and regulations for the M.S. degree examinations in Otorhinolaryngology to be held in April 2013.

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Date:

CERTIFICATE

This is to certify that the dissertation presented **"A COMPARATIVE STUDY BETWEEN MODIFIED UNDERLAY MYRINGOPLASTY WITH GRAFT OVER THE HANDLE OF MALLEUS AND CLASSICAL UNDERLAY TECHNIQUE WITH GRAFT UNDER THE HANDLE OF MALLEUS"** herein by **DR.V.A.KARTHIKEYAN,** is an original work done in the Department of Otorhinolaryngology, Government Stanley Medical College and Hospital, Chennai in partial fulfillment of regulations of the Tamilnadu Dr. M.G.R. Medical University for the award of degree of M.S. (Otorhinolaryngology) Branch IV, under my supervision during the academic period 2010-2013.

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CONTENTS

INTRODUCTION

Chronic otitis media (COM) is defined as chronic inflammation of mucoperiosteal lining of part or whole of the middle ear cleft. It has been recognized since prehistoric times. It is classified into two types, mucosal and squamous, of which mucosal type is characterized by intermittent mucoid or mucopurulent discharge through a perforated tympanic membrane.

Although the introduction of antibiotics has reduced the mortality in COM, still surgery remains the definitive treatment modality for closure of tympanic membrane perforation.

From seventeenth to nineteenth century several attempts at closing tympanic membrane perforations were made using prosthetic materials like paper patch and cauterising agents.

Surgical repair of tympanic membrane was first attempted by Banzer (1640) with pig'sbladder[1]. In1878 Berthold devised the term myringoplasty [1, 3]. In 1952,Wullstein formally announced[2, 3]a technique of closing perforation. That time he used split thickness skin graft[2, 3].

In 1958 Heerman began to use temporalis fascia.[3]First Shea performed underlay tympanoplasty. He performed stapedectomy and he accidentally tore the ear drum. That time he successfully repaired the ear drum perforation with medial vein graft[3]. He placed the graft medial to the ear drum perforation. The use of fascia as an underlay graft was first reported by Storrs[3, 4] in 1961.In their classic underlay myringoplasty they placed the graft medial to the handle of malleus.[3, 4.]

In our study we compare the results of two techniques of underlay myringoplasty graftunder the handle of malleus and the graft over the handle of malleus in terms of graft uptake and hearing outcome.

AIMS AND OBJECTIVES

- To compare the two techniques of underlay myringoplasty modified underlay technique with graft over the handle of malleus and classical underlay technique with graft under the handle of malleus.
- To assess the **graft uptake** rate of these two techniques.
- To assess the **hearing outcome** of these two techniques.

MATERIALS AND METHODS

STUDY DESIGN	-	Prospective study.
STUDY PLACE	-	Department of E.N.T. Stanley Medical College.
STUDY PERIOD	-	Feb 2011 to Sep 2012
SAMPLE SIZE	-	60 patients.
FOLLOW UP PERIOD	-	6 Months

INCLUSION CRITERIA:

Both male and female patients between 18 to 60 years attending E.N.T. OPD at Stanley Medical College with following clinical findings were included

- Central perforation.
- Dry perforation.
- Ossicular chain intact and mobile.
- Mucosa of the middle ear normal and healthy.
- Good cochlear reserve.

EXCLUSION CRITERIA:

- Patients with adenoid enlargement.

- Presence of septic foci in nose or throat.
- Revision cases.
- Traumatic perforation
- Cases with mixed and sensorineural hearing loss.
- Anomaly of external or middle ear.
- Cases with extracranial or intracranial complications of CSOM

MATERIALS:

Surgical technique adopted in our study is underlay myringoplasty. All cases were done with assistance of endoscope. The equipment's used for this surgery listed below:

1) 0 degree Hopkins endoscope, 4 millimetres wide angled[5, 6]. (Same one that is used for nasal surgery).
2) CCD camera (storz, single chip).
3) Rosen's, sickle knife and other middle ear micro instruments were used.
4) Colour monitor which is facing the surgeon and light source cable.[6]
5) Maico ma 52 clinical diagnostic two channel audiometer provided with sound proof room for audiological assessment.

METHODOLOGY:

This study was conducted in a group of 60 patients in the department of E.N.T. Stanley Medical College in the time periods from February 2011 to September 2012 with a follow up period of 6 months.

The patients who were selected for surgery were admitted in the ward. Detail history was recorded in the case sheet. Clinical examinations were performed including tuning fork tests. Complete examination of both the ears was done. Presence of septic foci was ruled out by thorough examination of nose, paranasal sinuses, pharynx and larynx. Examination under microscope or endoscope was done in all cases to assess the ossicular status, condition of middle ear etc...Audiometric tests were done to document pre-operative hearing status. Diagnostic nasal endoscopy was done for all cases to rule out focal sepsis. Following investigations are taken for all patients for the purpose of anaesthetic fitness.

- complete haemogram
- Renal function tests
- Blood sugar
- HIV-ELISA (after consent)
- Blood grouping and typing

- Urine analysis
- chest X ray PA View
- ECG

were done for all cases included in the study.

Pure Tone Audiometry was done in a sound proof room using maico ma 52 clinical diagnostic two channel audiometer.

Patient and their relatives were clearly informed about nature of the disease, surgery and all possible outcomes and complications of surgery. Informed consent was obtained from each patient and one of his/her relative.

All cases were done under local anaesthesia. Pre medication and local infiltration used were same for all cases. All cases were done with the aid of endoscope.

About 30 patients with dry ear for more than 6 weeks were subjected to surgery, underlay myringoplasty graft, over the handle of malleus were considered group A. Of these 24 patients with unilateral disease and 6 patients with bilateral disease were taken up for the study. For patients with bilateral disease, worse ear in terms of hearing was taken up for surgery.

Another 30 patients with dry ear more than 6 weeks were subjected to underlay myringoplasty graft, under the handle of malleus were considered as group B. Of these 22 patients with unilateral disease and 8 patients with bilateral disease were taken up for the study. For patients with bilateral disease, worse ear in terms of hearing was taken for surgery.

Graft material of choice in all cases was temporalis fascia.[4, 7] following surgery mastoid dressing was done, that was changed on the post-operative day two. Sutures were removed on 7th post-operative day from the graft harvested site. Patients were treated with i.v antibiotics for 2- 3 days and oral antibiotics were continued for another one week.

In the first month patients were followed up every week. Next two months they followed up every 15 days. Then once in 2 or 3 months till the end of the study.

Post operatively following parameters were noted:

1) Graft taken

2) Graft not taken

3) Graft lateralisation

4) Atelectasis.

Pure tone audiometry was done after 3 months and documented. Pre and post-operative air bone (A-B) gap calculated by taking the averages of bone conduction and air conduction at the frequencies of 500,1000 and 2000 Hz. [7]

Even though socio-economic status influences the disease and its outcome, all the patients attending Stanley Medical College & Hospital belong to lower socio-economic group. Hence this parameter was excluded in this study.

Myringoplasty:

Myringoplasty can be done under local or general anaesthesia.[5]But in this study all cases were done under local anaesthesia.

GENERAL ANESTHESIA -ADVANTAGES:

- Airway is better secured
- Better choice in paediatric population.
- Apprehensive patients are benefited.
- Patient is more comfortable under GA

LOCAL ANAESTHESIA -ADVANTAGES:

- Minimal bleeding and better field of surgery
- Early ambulation
- low cost

OPERATIVE TECHNIQUE:

Patient positioning[8]:

For the surgeon to accomplish the goal of grafting, the head must be positioned. Bringing the patient close to the edge of the bed prevents the surgeon from overextending his/her hands, thus increasing stability. It also assists in correct upright posture. The patient's arm on the operating side should be padded and tucked close to the body. The patient's head should be placed on a doughnut-shaped pillow approximately 3 to 4 inches thick. Care should be taken to ensure that the contralateral ear is not folded. This arrangement provides stability for the patient's head and allows the head to be rotated along the neck axis. A hydraulic chair without armrests greatly assists the surgeon by allowing better angles of approach with minimal repositioning. An operating table that can rotate about its long axis assists in obviating the need of the surgeon to change position and facilitates achieving the desired angle of exposure with less effort. Finally, the patient's head needs to be placed at the foot of the bed so there is adequate room for the surgeon's legs beneath the table. The anaesthesiologist should be at the foot of the bed. The blood pressure cuff should be placed on the arm contralateral to the surgeon.

Skin preparation and sterility:

A small area of skin of the scalp over the temporal region must be shaved to harvest the fascia so that 2 to 3 cm of hairless skin is visible. This operating area painted with povidone iodine solution and the same flushed into the external auditory canal and then sterile saline.

TECHNIQUE OF LOCAL ANAESTHESIA[9]:

All cases were sedated using injection fortwin 30 mg and injection promethazine 25 mg given intramuscularly half an hour before surgery. Pulse and oxygen saturation were monitored while giving local anaesthetic infiltration and throughout the surgery. Local anaesthesia consists of 2 per cent xylocaine mixed with 1 in 2, 00,000 adrenaline was used for local infiltration.

Infiltration of local anaesthetic agent was done under endoscopic visualisation. The four quadrants of the cartilaginous external auditory canal and the vascular strip region of the bony canal were injected[9] at 3, 6, 9, 12 o'clock positions.

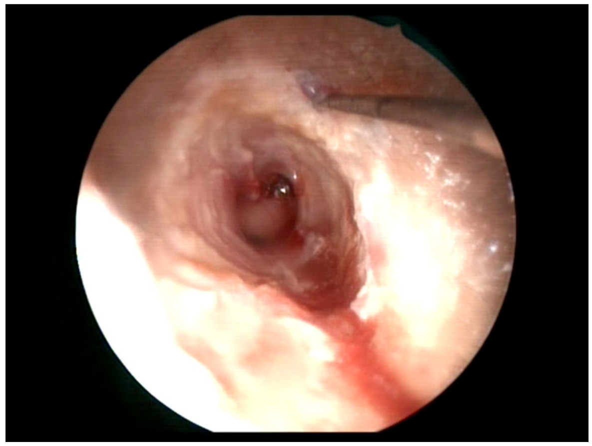


Fig.1: Local anaesthetic infiltration.

If properly given blanching of the canal skin will be noted and the injection will come out through the perforation. The bevelled edge of the needle should point towards the bone and the anaesthetic agent should be injected subperiosteally.

OPERATIVE PROCEDURE (GRAFT, LATERALTO THE HANDLE OF MALLEUS[10, 11]):

Through the superior incision temporalis fascia harvested, preserved and allowed to dry. The harvested site is sutured with 3-0 prolene.

Fig 2&3: Pictures showing temporalis fascia graft harvesting.

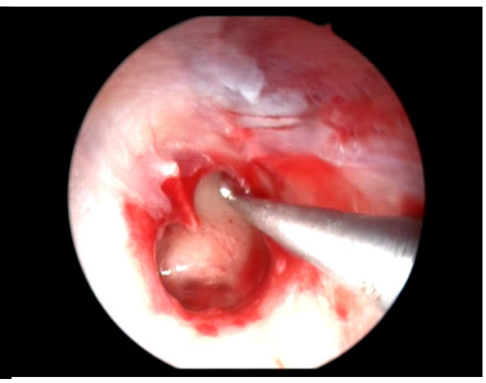



Fig.4: Excision of the rim of perforation

Fig.5: Removal of squamous epithelium from undersurface of perforation

The rim of the perforation is excised with sickle knife and cup forceps. It helps to remove the adhesions that present between the squamous margin of the tympanic membrane and the mucosa of the middle ear and to expose the free rim of fibrous layer of the tympanic membrane. Then, the under surface of the drum remnant was denuded of squamous epithelium with Rosen's round knife.

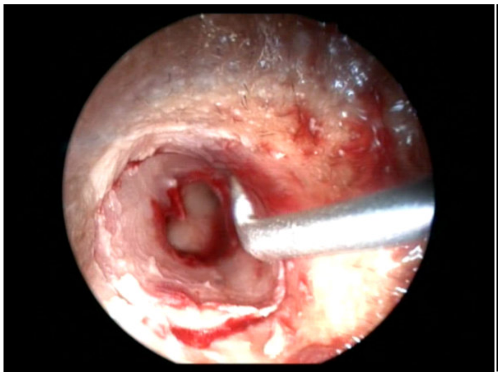
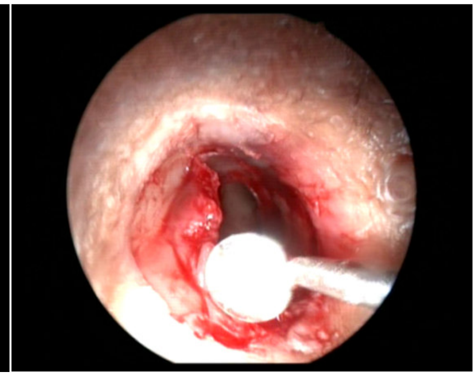



Fig.6: Tympanomeatal incision Fig.7: flap elevation

Next step is elevation of tympanomeatal flap. Tympanomeatal incision was made 270 ^{0} from 10 o' clock all around to 2 o' clock on both sides by leaving the anterior aspect. Tympanomeatal flap is elevated through the incision. Tympanomeatal flap is elevated down to the fibrous annulus.The fibrous annulus is mobilized out of the sulcus and displaced anterior to the malleus. After mobilization of the flap from the sulcus, middle ear mucosa should be incised with sickle knife at once to prevent stripping of middle ear mucosa. Then the manubrium of the malleus denuded, preserving the fibrous annulus.

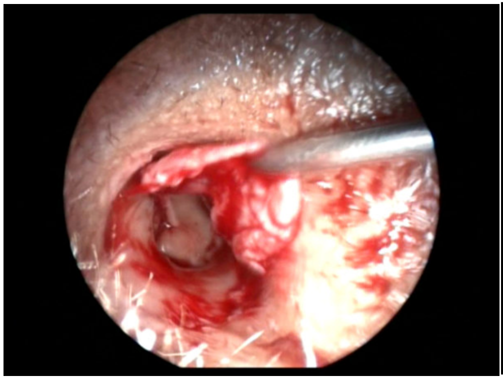
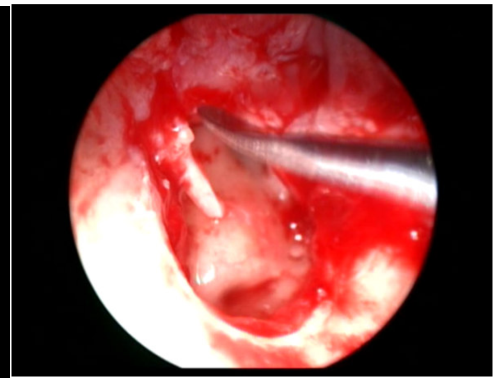
 

Fig.8: Mobilization of annulus from the sulcus.

Fig.9: Anterior elevation of annulus.

This step prevents invagination of squamous epithelium into the middle ear. Ossicular chain integrity confirmed. Anterior aspect of the annulus was elevated from the bone of external auditory canal for few millimeters.

Then the fascia graft is trimmed to appropriate size. Graft is introduced and inserted under the tympanomeatal flap and over the handle of malleus. Then part of the graft that facing anterior aspect of the annulus is inserted under the annulus that has been elevated anteriorly.

In this way anterior aspect of the graft supported by the annulus laterally and tympanic bone medially.

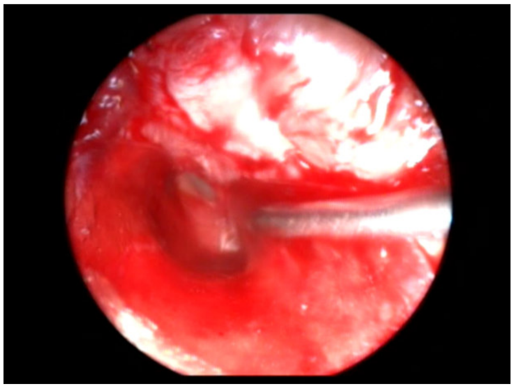
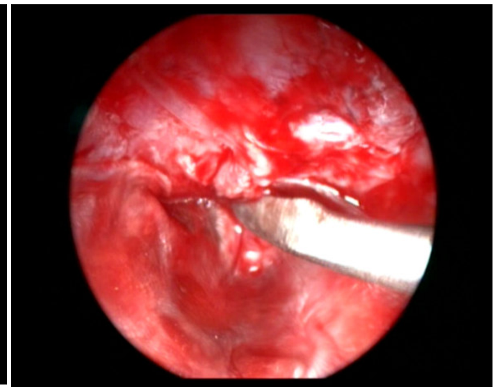



Fig.10: Graft is placed over the handle of malleus.

Fig.11: Graft is inserted anteriorly under the annulus.

Then tympanomeatal flap is repositioned after blocking the eustachian tube with gelfoam.

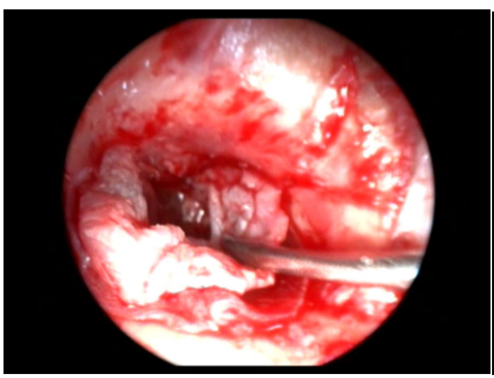
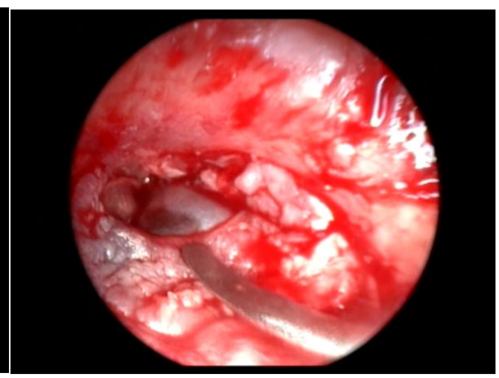



Fig.12& 13: Reposition of tympanomeatal flap.

Then gelfoam kept over the edges of the tympanomeatal flap.

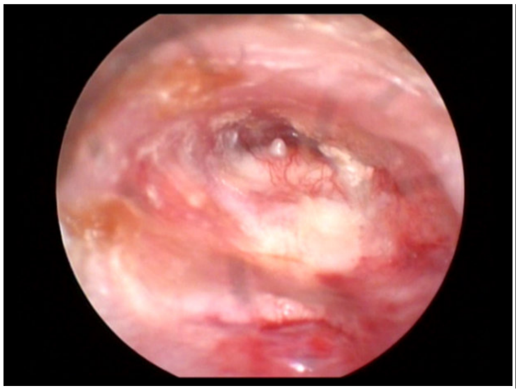


Fig.14: follow up picture at 4 weeks.

Fig.15: follow up picture at 12 weeks.

OPERATIVE PROCEDURE (GRAFT, MEDIAL TO THE HANDLE OF MALLEUS[2, 4-9]):

The rim of the perforation is excised and the under surface of the drum remnant denuded of squamous epithelium with Rosen’s round knife.

Next step is elevation of tympanomeatal flap. With Rosen’s knife tympanomeatal incision is made by marking the vascular strips at the tympanosquamous and tympanomastoid suture lines. The incision is made with the dominant surgeon’s hand while the non-dominant hand holding the endoscope. The tympanomeatal flap is elevated with Rosen’s knife and tympanomeatal flap elevator by giving pressure over the bone of the external auditory meatus. Haemostasis is obtained in between with the aid of adrenaline soaked cotton balls and 20 gauge needle suction tip.

The tympanomeatal flap is elevated down to the fibrous annulus. The fibrous annulus is mobilized out of the sulcus and displaced anterior to the malleus. After mobilization of annulus from the sulcus, mucosa of the middle ear should be incised in the same manner. Then the manubrium of the malleus denuded, preserving the fibrous annulus. Working through the endoscope, the surgeon can obtain an excellent view of the anterior annulus simply by rotating the endoscope anteriorly. Even with a prominent anterior canal wall bulge, it is seldom necessary to remove bone in this area to see the annulus.

Haemostasis should be achieved prior to graft placement with Gelfoam saturated in 1:1,000 adrenaline packed into the middle ear space while the graft is being trimmed. The dried graft is trimmed to appropriate size. A slit is made in the superior aspect of the graft to accommodate placement medial to the manubrium. The adrenaline soaked gelfoam is removed and the middle ear space is filled with plain Gelfoam[12]. Particular care is exercised in packing the middle ear with Gelfoam. Packing is started at the eustachian tube region and proceeds posteriorly. Adequate Gelfoam should be kept in the eustachian tube region to avoid medial collapse of the graft anteriorly, which results in failure. Then the graft is slid medial to the manubrium and onto the lateral attic wall.

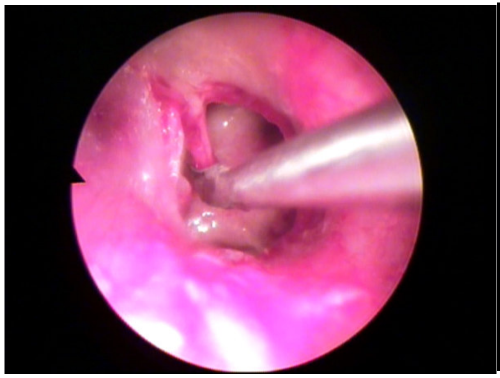
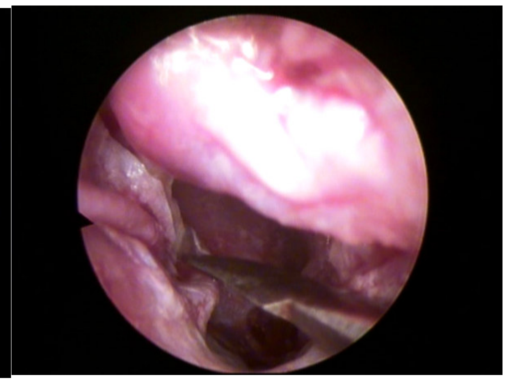



Fig.16: skeletonising the malleus.

Fig.17: Graft is placed medial to the malleus.

A House annulus elevator is used to tuck the graft under the drum remnant anteriorly and inferiorly. Then the tympanomeatal flap is replaced in its original position. Bits of gelfoam are kept surrounding the tympanomeatal flap. One is placed over the graft that covers the perforation. It sucks out the fascia against the margins of the perforation. So graft medialisation is prevented.

REVIEW OF LITERATURE

EMBRYOLOGY:

Development of Temporal Bone, External Auditory Canal, Tympanic Ring, and Tympanic Membrane:

The adult temporal bone is an amalgam of the squamous, petrous, mastoid, tympanic, and styloid bones. The close association of the external auditory canal, tympanic ring, and tympanic membrane justifies the inclusion of their developmental process in conjunction with that of the temporal bone as a whole. The development of the bony labyrinth and petrosa, however, because of its intricacy, warrants separate discussion. The following account of the development of the external auditory canal, tympanic ring, tympanic membrane, and temporal bone is derived from the works of Anson and associates as well as Pearson. The dorsal part of the first branchial groove, which gives rise to the external auditory canal, progressively deepens during the second month. The ectoderm of the groove briefly abuts on the endoderm of the tubotympanic recess (first pharyngeal pouch), but during the sixth week, a mesodermal in growth breaks this contact. Beginning at 8 weeks, the inferior portion of the first branchial groove deepens again, forming the primary external auditory canal, which corresponds to the fibrocartilaginous canal of the adult. At the same time, development of the squama begins, marked by the appearance of a membranous bone ossification center. In the next week of development, a cord of epithelial cells at the depths of the primary external auditory canal grows medially into the mesenchyme to terminate in a solid (meatal) plate. The mesenchyme adjacent to the meatal plate gives rise to the lamina propria (fibrous layer) of the tympanic membrane and at 9 weeks is surrounded by the four membranous bone ossification centers of the tympanic ring. In addition to supporting the tympanic membrane, it has been theorized that the tympanic ring also functions to inhibit inward epithelial migration. Failure of this function may lead to cholesteatoma formation (i.e. congenital cholesteatoma) at the junction of the first and second branchial arches.

By the tenth week, the tympanic ring elements fuse except superiorly, where a defect remains the notch of Rivinus. These elements then expand, accompanied by growth of the solid epithelial cord of cells. It is not until after the fifth month that the cord splits open, initially at its medial terminus, forming the bony external auditory canal by the seventh month. The cells remaining at the periphery form the epithelial lining of the bony external auditory canal, whereas those remaining medially form the superficial layer of the tympanic membrane. The medial layer of the tympanic membrane derives from the epithelial lining of the first pharyngeal pouch. These developmental changes in the external auditory canal occur at a time when the outer, middle and inner ear are already well developed.

Meanwhile, beginning at 4 months, the squama projects posterior to the tympanic ring, forming what will become the lateral (squamous) portion of the mastoid, roof of the external auditory canal, and lateral wall of the antrum. The medial (petrous) portion of the mastoid develops as air cells invade the periosteal layer of the bony labyrinth. The external petrosquamous fissure marks the junction of the petrosa with the squama and generally disappears by the second year of life. The hypotympanum develops between 22 and 32 weeks as a tripartite bony amalgam composed of the tympanic bone (membranous bone), the canalicularotic capsule (enchondral bone), and a petrosal ledge (periosteal bone). This variegated structure is thought to predispose this area to anomalous development, such as that which leaves bare the jugular bulb in the middle ear. After the eighth month, the tympanic ring begins to fuse with the otic capsule, a process that is not completed until birth. Postnatally, lateral extensions of the tympanic ring and the squama extend the external auditory canal and carry the tympanic membrane from the horizontal angulation of the neonate to the acute angulation of the adult. The styloid process does not make its appearance until after birth, arising in an ossification Centre at the upper aspect of Reichert's cartilage.

Microtia, anotia, and aberrant positioning of the pinna derive from abnormal development of the first and second branchial arches. Developmental failure of the first branchial groove results in stenosis or atresia of the external auditory canal, based on either a lack of canalization of the meatal plate or a deficiency in epithelial in growth. The presence or absence of accompanying defects in the middle and inner ears depends on the time period at which development was disrupted.

Development of middle ear cleft:

The eustachian tube, tympanic cavity, attic, antrum and mastoid air cells develop from the endoderm of the tubo tympanic recess which arises from the first and partly from the second pharyngeal pouches.

Malleus and incus are derived from mesoderm of the first arch while stapes develop from the second arch except its foot plate and annular ligament which are derived from the otic capsule.

ANATOMY OF EAR

Temporal bone:[13] The temporal bone is a composite structure consisting of the tympanic bone, mastoid process, squama, petrosa. Although styloid process is closely related to the temporal bone, it is not considered to be a portion of it. The tympanic, squamous and mastoid portions of the temporal bone are evident on the lateral view. The tympanic bone forms the anterior, inferior and parts of posterior wall of the external auditory canal.

Ear: It can be divided into 3 parts both functionally and anatomically.

External ear:

Pinna and external auditory canal[13]:

The pinna acts to focus and aid in the localization of sound. Its shape, showing considerable inter individual variability, reflects its multi component embryologic origin. Nonetheless, there are constant features. The contour of the pinna is determined by the configuration of its elastic cartilage frame. The lateral surface of the pinna is dominated by concavities, in particular the concha. The skin of the lateral and medial surfaces of the pinna possesses hair and both sebaceousand sudoriferous glands; however, the attachment of the skin differs, being tightly bound down to the perichondrium on the lateral aspect and only loosely attached on the medial. The pinna is securely attached to the tympanic bone by the continuity of its cartilage with that of the cartilaginous external auditory canal (EAC). Otherwise, the pinna loosely attaches to the skull by its skin, connective tissue, ligaments, and three extrinsic and six intrinsic muscles. A branch of the facial nerve, the posterior auricular nerve, innervates the intrinsic muscles, in general poorly developed in the human.

External auditory canal:

The lateral one-third of the EAC comprises a continuation of the cartilage of the pinna and is deficient superiorly at the incisuraterminalis. The extra cartilaginous endaural incision for access to the underlying temporal bone capitalizes on this gap. The two or three variably present perforations in the anterior aspect of the cartilaginous canal are the fissures of Santorini. The remaining medial two-thirds of the approximately 2.5-cm length of the canal are bony. The isthmus, the narrowest portion of the EAC, lies just medial to the junction of the bony and cartilaginous canals. The skin of the cartilaginous canal has a substantial subcutaneous layer, replete with hair follicles, sebaceous glands, and cerumen glands. The skin of the osseous canal, in contrast, is very thin and its subcutaneous layer is bereft of the usual adnexal structures. Accordingly, the absence of hair serves to distinguish the bony and cartilaginous canals.

Innervation:

The auriculotemporal branch of the trigeminal nerve, greater auricular nerve (a branch of C3), lesser occipital nerve (of C2 and C3 derivation), auricular branch of the vagus nerve (Arnold's nerve), and twigs from the facial nerve all contribute to the sensory innervation of the pinna and EAC. Effective local anaesthesia can be obtained by 1 to 2% lidocaine infiltration of the post auricular region accompanied by infiltration of the cartilaginous canal in a four-quadrant (ie, at the 2, 4, 8, and 10 o'clock positions) fashion. Infiltration of the bony canal must be done gently to avoid troublesome bleb formation; if done properly, the anchoring of the skin of the bony EAC "outlines" the tympanomastoid and tympanosquamous sutures, which are the landmarks for the "vascular strip" incisions. Inflammation, as with infection of the middle ear or external ear, reduces the efficacy of local anaesthesia.

Vascular Supply:

Two branches of the external carotid artery, the posterior auricular artery and the superficial temporal artery, are the sources of arterial blood supply to the pinna and EAC. The posterior auricular artery, as it courses superiorly on the mastoid portion of the temporal bone, supplies the skin of the pinna and the skin and bone of the mastoid; its stylomastoid branch enters the fallopian canal to supply the inferior segment of the facial nerve. Anteriorly, a few twigs of the superficial temporal artery provide additional supply to the pinna and EAC. The veins accompanying the arteries drain into the internal jugular vein by either the facial or external jugular veins.

Middle ear cleft:

The middle ear cleft consists of the tympanic cavity, the eustachian tube and the mastoid air cell system. Of these tympanic cavity is an irregular, air filled space within the temporal bone and contains auditory ossicles and their attached muscles.

The tympanic membrane:

The tympanic membrane emulates an irregular cone, the apex of which is formed by the umbo (at the tip of the manubrium). The adult tympanic membrane is about 9 mm in diameter and subtends an acute angle with respect to the inferior wall of the EAC. The fibrous annulus of the tympanic membrane anchors it in the tympanic sulcus. In addition, the tympanic membrane firmly attaches to the malleus at the lateral process and at the umbo; between these two points, only a flimsy mucosal fold, the plica mallearis, connects the tympanic membrane to the malleus.

The tympanic membrane is separated into a superior pars flaccida (Shrapnell's membrane) and a pars inferior by the anterior and posterior tympanic stria, which runs from the lateral process of the malleus to the anterior and posterior tympanic spines, respectively. Shrapnell's membrane serves as the lateral wall of Prussak's space (the superior recess of the tympanic membrane); the head and neck of the malleus, the lateral malleal ligament, and anterior and posterior malleal folds form the medial, anterosuperior, and inferior limits of Prussak's space. The tympanic membrane is a trilaminar structure. The lateral surface is formed by squamous epithelium, whereas the medial layer is a continuation of the mucosal epithelium of the middle ear. Between these layers is a fibrous layer, known as the pars propria. The pars propria at the umbo splits to envelop the distal tip of the manubrium.

Ossicles: The ossicular chain, made up of the malleus, incus, and stapes, serves to conduct sound from the tympanic membrane to the cochlea.

The malleus, the most lateral of the ossicles, has a head (caput), manubrium (handle), neck, and anterior and lateral processes. The lateral process has a cartilaginous "cap" that imperceptibly merges with the pars propria of the tympanic membrane. The anterior ligament of the malleus, extending from the anterior process, passes through the petrotympanic fissure and, with the posterior incudal ligament, creates the axis of ossicular rotation. The incus, the largest of the three ossicles, is immediately medial to the malleus. The incus has a body and three processes: a long, a short, and a lenticular. The body of the incus articulates with the head of the malleus in the epitympanum. The short process of the incus is anchored in the incudal fossa by the posterior incudal ligament. The long process extends inferiorly, roughly paralleling and lying posterior to the manubrium. The lenticular process, at the terminus of the long process, articulates with the stapes.

The stapes is the smallest and most medial of the ossicles. Its head articulates with the lenticular process of the incus, whereas its footplate sits in the oval window, surrounded by the stapedio vestibular ligament. The arch of the stapes composed of anterior and posterior crus, links the head and the footplate. In the course of tympanic membrane elevation, as for instance in tympanoplasty, since the cartilaginous “cap” of the lateral process of the malleus blends into the pars propria of the drum, it is more expedient to sharply dissect it from the malleus rather than tediously attempting to dissect the drum from the “cap.” The long process of the incus, perhaps owing to its tenuous blood supply, is particularly prone to osteitic resorption in the face of chronic otitis media. Although the ossicles are held in position by their ligaments and tendons, the force of injudicious surgical manipulation can easily overcome these restraints, resulting in subluxation or complete luxation. When dissecting disease from the stapes, one should parallel the plane of the stapedius tendon, in a posterior to an anterior direction, so that the tendon resists displacement of the stapes.

- **Spaces** – planes extended from the tympanic annulus subdivide the tympanic cavity into a mesotympanum, hypotympanum, protympanum and posterior tympanic cavity. The epitympanum lies above the plane of the anterior and posterior tympanic spines.

Inner Ear –The bony labyrinth houses the sensory organs and soft tissue structures of the inner ear and consists of the cochlea, three semicircular canals, and vestibule.

Vestibule is the central portion of the bony labyrinth and is a small flattened ovoid chamber lying between the middle ear and the fundus of the internal auditory meatus.

Cochlea: The cochlea spirals 2½turns about its central axis, the modiolus, and has a height of 5 mm. The base of the cochlea abuts the fundus of the IAC and is perforated (cribrose), allowing for the passage of cochlear nerve fibres. The apex lies medial to the tensor tympani muscle. The osseous spiral lamina winds about the modiolus and, along with the basilar membrane, separate the scala media (the cochlear duct) from the scala tympani. Adjacent turns of the cochlea are separated by an interscalar septum.

The three semicircular canals are the lateral (horizontal), superior (anterior vertical), and posterior (posterior vertical). The three canals are orthogonally related to one another and arc over a span of 240 degrees. Each canal has an ampullated limb, measuring 2 mm in diameter, and a non ampullated limb, which is 1 mm in diameter. The ampulla is cribrose for passage of nerve fibers. The non ampullated limbs of the posterior and superior canals fuse to form the crus commune. The ampullated and non ampullated limbs all open into the vestibule. The angle formed by the three semicircular canals is the solid angle, whereas the triangle bounded by the bony labyrinth, sigmoid sinus, and superior petrosal sinus is known as Trautmann's triangle.

The nerve fibres from the labyrinth form the eighth nerve which consists of a cochlear nerve, superior division and inferior division of vestibular nerve. Through the internal auditory canal it enters the cranial cavity.

TEMPORALIS FACIA[4]:

Temporal fascia, which is a tough fan-shaped aponeurosis overlying the temporalis muscle and attached by its outer margin to the superior temporal line and by its inferior margin to the zygomatic arch.

Graft material of choice in myringoplasty for many ENT surgeons is temporalis fascia for the following reasons[4]:

- Success rate is high.
- Low basal metabolic rate of temporalis fascia makes it to survive even in least favourable environment.
- It is available close to the operating site so preparation is eas
- Hearing outcome is better with temporalis fascia because thickness is same as natural ear drum.
- Being an autograft it excludes the fear of transmission of diseases from cadavers or humans.
- Available in plenty.

Other common graft materials used are vein graft, fascia lata, perichondrium and the tissue present above the temporalis fascia. Cadaveric dura can also be used for this surgery.

PHYSIOLOGY OF SOUND TRANSMISSION:

SOUND AND SOUND WAVES:

Sound results when particles of a medium are set into vibration. For example, the vibrating tines of a struck tuning fork produce backward and forward motions of the air particles that surround the tines.

HEARING MECHANISM[14]:

A sound wave enters the external acoustic meatus and strikes the tympanic membrane moves the TM and handle of malleus medially because of its attachment to the tympanic membrane. This movement makes the head of malleus to move laterally. Because of incudomalleolar joint incus moves laterally. This pushes the long process of incus medially. Because of incudostapedial joint its movement causes the stapes to move medially. In turn base of stapes attached to the oval window, oval window moves medially.

This action completes the transfer of large amplitude, low force, airborne wave that vibrates the tympanic membrane into a small amplitude, high force vibration of the oval window, which generates a wave in the fluid filled scala vestibule of the cochlea.

The wave established in the perilymph of the scala vestibule moves through the cochlea and causes an outward bulging of the secondary tympanic membrane covering the round window at the lower end of scalatymapani. This causes the basilar membrane to vibrate, which in turn leads to stimulation of receptor cells in the spiral ganglion.

The receptor cells transmit the impulses back to the brain via the cochlear part the eighth nerve where they are perceived as sound.

If sounds are too loud, causing excessive movement of tympanic membrane produces the contraction of the tensor tympani and stapedius muscle and dampens the vibrations of the ossicles and decreases the force of the vibrations reaching the oval window.

THEORIES OF HEARING[15]:

Place theory:

This theory was proposed by Hermann Helmholtz. This theory is based on the assumption that pitch discrimination takes place at the level of cochlea. Helmholtz was able to demonstrate that the basal turn of cochlea responded best to high frequency sounds while the apical portion of cochlea responded better to low frequency sounds. He assumed that the middle portion of the cochlea responded to various middle frequency sounds. He considered the basilar membrane to be tuned like the string of a piano. When sound reaches the ear the various frequencies stimulate various portions of the basilar membrane playing a role in pitch discrimination. Experiments particularly the present day ones have not categorically proved that pitch discrimination occurs at the level of cochlea, it has to be accepted that certain amount of gross pitch discrimination takes place at the level of cochlea.

Telephone theory (Pitch theory):

This theory was proposed by Rutherford. This theory suggests that pitch discrimination takes place at the level of auditory nerves. According to this theory all portions of the basilar membrane are stimulated by every frequency and the pitch perception depends on the number of times the auditory nerve fibres discharge. Studies have demonstrated that maximal discharge rate of auditory nerve fibres is 1000/sec. This indicates that pitch discrimination of frequencies above this frequency cannot be perceived hence this theory is also not a complete explanation of sound perception by brain.

Volley theory:

This theory was proposed by Weaver. This theory is a judicial combination of place theory and telephone theory. Perception of sound with frequencies up to 5000Hz depends on the firing rate of auditory nerves (pitch theory) and frequencies above 5000 Hz depends on maximal excitation of various portions of cochlea (place theory).

Travelling wave theory of Bekesy:

This is one type of place theory. This theory holds that pitch discrimination is determined when a certain place along the basilar membrane is set into maximum vibration. The auditory nerve fibres supplying the maximally vibrating portion of basilar membrane start to fire in response to it.

MIDDLE EAR TRANSFORMERS:[16]

Catenary lever:

Helmholtz was first to propose a concept of a catenary lever to the action of tympanic membrane. A familiar example of this type of lever is tennis net. The tighter the tennis net stretched, the greater force is exerted on the posts holding it. Because the bony annulus is immobile, sound energy applies to the tympanic membrane is amplified at the central attachment, the malleus. It is estimated that even though the curvature of the tympanic membrane is variable, the catenary lever provides at least two times gain in sound pressure at the malleus. Force exerted on the stretched curved fibers of the tympanic membrane are amplified at its point of attachment, the annular bone is immobile, so that the malleus is the recipient of this magnified energy, directing it into the ossicular chain for transmission to the perilymphatic fluid.

Ossicular lever:

The lever action that results from the different lengths of the rotating malleus and incus arms around the axis of rotation of the ossicles. The axis of rotation is an imaginary line joining the anterior malleal ligament to the incudal ligament that anchors the short process of the incus. The malleus and incus lever arms in humans are nearly the same length. Hence, the ratio of these lengths, which is 1.3, predicts a small, 2-dB increase in sound pressure applied by the stapes to the inner ear.

Hydraulic lever:

Helmholtz's third concept of impedance matching is referred as area ratio. The effective vibratory area of tympanic membrane is 55 mm sq. whereas foot plate area is 3.2 mm sq. hence effective area ratio is 14:1. This is a mechanical advantage provided by tympanic membrane. The product of areal ratio into lever ratio is known as transformer ratio i.e. 14x1.3=18:1

Phase difference:

In the normal ear sound pressure waves never reach the oval window and round window in the same phase, due to the presence of tympanic membrane, middle ear and air cushions. If air waves reach round window and the oval window at the same time it cancel the effect of sound waves leading to stasis of perilymph. This reciprocal action at oval window and round window is cancelled as phase difference. Therefore, loss of this phase difference (large or posteriorly based perforations) may lead to more conductive hearing loss. However in normal case sound wave reaches oval window earlier than round window which is also an added advantage of hearing.

Ossicular and acoustic coupling:

The contribution of the middle ear to the window pressure difference that stimulates the inner ear can be split into several stimulus pathways. A previous section described how the tympano-ossicular system transforms sound pressure in the ear canal to sound pressure at the oval window. This pathway has been termed ossicular coupling. There is another mechanism, called acoustic coupling, through which the middle ear can stimulate the inner ear. Motion of the tympanic membrane in response to ear canal sound creates sound pressure in the middle ear cavity. Because the cochlear windows are separated by a few millimetres, the acoustic sound pressures at the oval and round windows, respectively, are similar but not identical. Small differences between the magnitudes and phases of the sound pressures outside the two windows result in a small but measurable difference in sound pressure between the two windows. In the normal ear, the magnitude of this acoustically coupled window pressure difference is small, on the order of 60 dB less than ossicular coupling. Hence, ossicular coupling dominates normal middle ear function, and one can ignore acoustic coupling. However, as will be seen later, acoustic coupling can play an important role when ossicular coupling is compromised, as in some diseased and reconstructed ears.

MIDDLE EAR GAS EXCHANGE MECHANISM:

Like the lung, the middle ear is an organ in the human body that must maintain an aerated cavity within it for the fulfillment of its function. When hypoventilation occurs in the lungs it threatens the maintenance of life, and when it occurs in the middle ear it causes loss of hearing, which is an important function for maintaining the quality of life. Because of similarity in their functions, the lung and middle ear also have many similarities in structure, bluestone et al. (1981) compared the eustachian tube with the larynx and the middle ear and mastoid to the lung, and suggested that the eustachian tube, middle ear, and mastoid are involved in the ventilation of the middle ear just the larynx and lungs are involved with that of the body. He also pointed out the similarities of otitis media atelectatic ear in the middle ear and pneumonia or atelectasis in the lungs as pathophysiological conditions of these organs caused by their organic or functional failures

Thus, in order to maintain physiologicalcondition of the middle ear, ventilation and pressure regulation are regarded as the most important functions.

In short middle ear is also ventilated by transmucosal gas exchange, which is passive exchange of gases through the middle ear mucosa. The gas exchange is slow that it cannot cope with a sudden change in atmospheric pressure, but it has the advantage that it works constantly even during sleep. The gas exchange function is impaired by inflammatory thickening of mucosa, and stops completely when the air space in the middle ear is lost.

CHRONIC OTITIS MEDIA:

DEFINITION:

Chronic otitis media (COM) is, defined as a chronic inflammation of the middle ear and mastoid cavity, which presents with recurrent ear discharges or otorrhea through a tympanic perforation.

AETIOLOGY OF TYMPANIC MEMBRANE PERFORATIONS:

BACTERIAL[17]:

Bacterial infection of the middle ear causes acute otitis media, which often results in a small perforation through which purulent material discharges. These perforations heal spontaneously in a short time unless complicating factors coexists. Eustachian tube dysfunction is the major factor that results in a permanent perforation. In such a middle ear, the mucus membrane is exposed to repeated infection, both through the external auditory canal and through the Eustachian tube, with chronic continuous discharge or with recurring episodes of suppurative otitis media. Allergic sensitization of the exposed middle ear mucosa frequently occurs. Such disease is termed active chronic otitis media without cholesteatoma. The incidence of the condition varies widely by geography, race, and genetic predisposition, as well as socioeconomic factors.

Beta-haemolytic streptococci are capable of inciting a Necrotizing form of acute suppurative otitis media, especially in children suffering from measles or scarlet fever. The pathogenic characteristics of the infecting species of bacterium cause capillary infarction and subsequent ischemic necrosis of tissue. Thus, large portions of the tympanic membrane (where the blood supply is poorest) become necrotic and slough, usually leaving intact the better nourished annular rim, the area near the handle of the malleus, and the pars flaccida. The resulting kidney shaped perforation is called a central perforation because of the marginal rim that remains. After the acute episode of necrotizing otitis media has subsided, the perforation may heal spontaneously, leaving a thin atrophic scar, or may remain permanently open. The microcirculation of the middle ear also is disrupted, leading to tympanosclerosis, in which healing involves an ossification process with variable involvement of the middle ear structures.

Mycobacterial[17]:

Mycobacterial infection of the tympanic membrane is primarily caused by Mycobacterium tuberculosis and, to a lesser degree, atypical mycobacteria. This condition manifests as a relentless, low-grade inflammation of the tympanic membrane that is refractory to conventional (oral or topical) antibiotic treatment. It eventually results in multiple small perforations that subsequently coalesce.

PATHOLOGY OF TYMPANIC MEMBRANE PERFORATIONS:

As documented in the experimental animal, proliferation of stratified squamous epithelium at the rim of a perforation begins within 12 hours, and granulation tissue growth begins at 36 hours. Regeneration of the epithelium of the inner (mucosal) surface is more sluggish and begins only after several days. As long as there is a suitably flat surface, stratified squamous epithelium grows at the rate of 1 mm a day. Histopathologic examination of permanent perforations showed that stratified squamous epithelium grows medially over the edge of the perforation, which appears to arrest the subsequent closure of the perforation. Removal of this medialized epithelium forms the basis of some of the treatments for tympanic membrane perforation. The cytokines implicated in this arrest of healing may be multiple, but transforming growth factor- 1 (TGF-1) is found at the border of the chronic perforation and may mediate the arrest of healing. This is the reason why we excising the margin of the perforation while doing myringoplasty.

EFFECTS OF TYMPANIC MEMBRANE PERFORATIONS ON HEARING:[18]

Perforations of the tympanic membrane cause a conductive hearing loss that can range from negligible to 50 dB. The primary mechanism of conductive loss caused by a perforation is a reduction in ossicular coupling caused by a loss in the sound pressure difference across the tympanic membrane. The sound pressure difference across the tympanic membrane provides the primary drive to the motion of the drum and ossicles. Perforation-induced physical changes such as reduction in tympanic membrane area or changes in coupling of tympanic membrane motion to the malleus do not appear to contribute significantly to the hearing loss caused by a perforation. Perforations cause a loss that depends on frequency, perforation size, and middle ear air space volume. Perforation-induced losses are greatest at the lowest frequencies and generally decrease as frequency increases. Perforation size is an important determinant of the loss; larger perforations result in larger hearing losses. The volume of the middle ear air space (combined tympanic cavity and mastoid air volume) is also an important parameter that determines the amount of hearing loss caused by a perforation; small middle ear air space volumes result in larger air–bone gaps. Other things being equal, for a given sound pressure in the ear canal and a given perforation, the resulting sound pressure within the middle ear cavity will vary inversely with middle ear volume. Hence, the transtympanic membrane sound pressure difference will be smaller (and the conductive loss correspondingly greater) with smaller middle ear volumes. Identical perforations in two different ears can have conductive losses that differ by up to 20to 30 dB if the middle ear air space volumes differ substantially (within normal ears, middle ear air space volume can range from 2 cm3 to 20 cm3).

PATHOGENESIS AND CLASSIFICATION OF CHRONIC OTITIS MEDIA[19]:

Central perforation of the tympanic membrane can remain dry, with only rare intermittent drainage, that is, inactive chronic otitis media[19]. More typically, chronic or recurrent mucoid otorrhea, that is, active chronic otitis media[19], is provoked by exposure of the tympanic mucosa to bacteria of the external auditory canal as well as of the eustachian tube.

Pseudomonas aeruginosa is the most common offending organism causing chronic otitis media.[17]Other isolates include enteric aerobic gram-negative bacilli such as Proteus, E.coli and gram positive Staphylococcus aureus, Streptococcus, gram negative Haemophilus influenza. Anaerobic organisms are associated with foul smelling discharge include Bacteroids and Peptostreptococcus species.[17]

Otoscopy, or preferably examination with an operating microscope, reveals a tympanic membrane perforation and, in active disease, mucoid or mucopurulent discharge. The presence of an aural polyp or malodorous otorrhea should raise the clinician's suspicion regarding the presence of cholesteatoma. After careful aspiration of any debris, the status of the middle ear mucosa can be assessed through the perforation and can appear only slightly thickened, with ciliary activity visualized, or can be markedly thickened, with polypoid degeneration. The ossicular chain can be intact, or disrupted, with the long process of the incus most prone to resorption. The mobility of the stapes can be assessed by microscopic examination combined with Barany noise box stimulation of the contralateral ear, taking advantage of the crossed stapes reflex.

On histopathologic examination, the middle ear mucosa is oedematous, with sub mucosal fibrosis and Infiltration by chronic inflammatory cells. The mucosal oedema can lead to the formation of aural polyps, which can even project into the external auditory canal. Bone erosion, including ossicular resorption, mucosal ulceration, and the formation of granulation tissue, is the correlate of persistent otorrhea. Mucosal thickening can impair ossicular and tympanic membrane mobility, aggravated by the deposition of hyalinised cartilage (i.e., tympanosclerosis).

The treatment of chronic otitis media focuses on the mucosal infection in the tympanomastoid compartment. After aspiration of retained debris, aural toilet comprising 1.5% acetic acid (one part white vinegar to two parts water) irrigation (at body temperature, three times daily with an ear/ulcer syringe) followed by the instillation of topical antibiotic drops (e.g., ciprofloxacin, sulfacetamide) Suffices to bring most infections under control. The acetic acid irrigation removes accumulated debris and acidifies the external auditory to canal, discouraging growth of Pseudomonas and other bacteria. Any underlying allergies and/or nasopharyngeal disorder should be managed and closure of the tympanic membrane perforation undertaken as soon as the ear becomes dry.

AUDIOLOGICAL ASSESSMENT:

Clinical tests of hearing:

- Finger friction test
- Watch test
- Speech test
- Tuning fork test[20]

These tests are performed with tuning forks of different frequencies such as 256, 512, 1024 Hz but for the routine clinical practice, tuning fork of 512 Hz is ideal.[20]

A Prediction of air- bone gap can be made if tuning forks of 256, 512, and 1024 Hz are used.

- A Rinne test equal or negative for 256 Hz but positive for 512 Hz indicates air bone gap of 20-30 decibel.
- A Rinne test equal or negative for 256 and 512 Hz but positive for 1024 Hz indicates air bone gap of 30- 45 decibel.
- A Rinne test negative for all the three tuning forks of 256, 512 and 1024 Hz, indicates air bone of 45- 60 decibel.

Weber's lateralized to the worse ear in conductive hearing loss. Weber's can be lateralized even when the Rinne is positive with 256 Hz tuning fork. Because weber's will be lateralized when there is 5 decibel difference between two ears. But at least 20 decibel hearing loss needed for the Rinne to get lateralized. For these reasons weber's test considered a more sensitive than Rinne.

Absolute bone conduction test is a measure of cochlear function. It is reduced in sensorineural hearing loss.

PURE TONE AUDIOMETRY:[21, 22]

Pure-tone audiometry is used to establish hearing threshold sensitivity at discrete frequencies across a range important for human communication. Threshold levels are plotted on an audiogram to show how threshold sensitivity varies across the frequency range. The complete pure-tone audiogram consists of air- and bone-conduction threshold curves for each ear.

The pure-tone audiogram is based on audiometric zero, or average normal hearing, across a defined frequency range. By definition, 0 dB HL is the average intensity level at which threshold of sensitivity is measured in normal-hearing individuals. For clinical purposes, the standard deviation is considered to be 5 dB, so that 95% of the normal population will have thresholds varying from –10 to +10 dB HL. Based on the pure-tone audiogram, then, hearing loss is often classified as minimal (15 to 25 dB), mild (25 to 40 dB), moderate (40 to 55 dB), moderately severe (55 to 70 dB), severe (70 to 90 dB), or profound (more than 90 dB). Although hearing loss in the minimal range may or may not result in impairment or handicap, it is incorrect to consider thresholds in this range to be within normal limits. The pure tone audiogram is also used to describe the shape of loss or the audiometric contour or configuration. The audiogram also provides a measure of interaural symmetry or the extent to which hearing sensitivity is the same in both ears or better in one than the other. In addition, the combination of air and bone-conduction audiometry is used to determine type of hearing loss.

USES OF PURE TONE AUDIOGRAM:[21, 22]

- It is a measure of threshold of hearing by air and bone conduction and thus the degree and type of hearing loss.
- A record can be kept for future reference.
- Audiogram is essential for the prescription of hearing aid.
- Helps to find degree of handicap for medico legal purposes.

- Helps to predict speech reception threshold.

Reporting of hearing results:

Kartush recommended the following guidelines for A-B gap closure to assess the hearing results. [23]

EXCELLENT	0-10 DECIBEL
GOOD	10-20 DECIBEL
FAIR	20-30 DECIBEL
POOR	>30 DECIBEL

INDICATIONS AND ADVANTAGES OF CLOSING THE PERFORATION:[18]

Protection:[18]

Closing a tympanic membrane perforation isolates the middle ear from the external environment and prevents contamination by exposure to pathogens introduced via the external auditory canal. Repeated exposure to pathogens can lead to recurrent, acute otitis media with consequent permanent alteration of the middle ear and its sound-transmitting mechanism and/or active, chronic otitis media with otorrhea that is refractory to treatment.

Auditory:

Closure of a tympanic membrane perforation restores the vibratory area of the membrane and affords round window protection, thus improving hearing and decreasing tinnitus; however, high-frequency audiometry demonstrates a persistent air–bone gap, despite successful closure of a perforation.48 An approximate estimate of the improvement in hearing and tinnitus that may be expected from closure of a perforation is obtained by temporary patching with cigarette paper or cellophane. If a carefully applied airtight patch does not eliminate the conductive loss, one may assume that an additional ossicular lesion is present, either fixation or discontinuity. In such cases, simple myringoplasty will not suffice. Closure must be accompanied or followed by correction of the ossicular problem by tympanoplasty.

CONTRAINDICATIONS TO CLOSURE OF A PERFORATION:[24]

Not every perforation needs to, or should, be closed. Each patient must be managed in accordance with what is best for that patient. An elderly or debilitated patient with an asymptomatic perforation, or a patient with a perforation in an only hearing ear, is not a good surgical candidate. In a young child with a perforation from a ventilation tube inserted because of poor ear ventilation, it is unwise to repair the tympanic membrane until it is apparent that eustachian tube function has significantly improved by the pathologic process repeat itself.

Absolute

The presence of cholesteatoma is an absolute contraindication for a myringoplasty. Active chronic otitis media with otorrhea refractory to medical management indicates the presence of an infectious focus, which needs to be surgically addressed prior to repair of the tympanic membrane. Medical contraindications to surgical intervention include advanced patient age. Last but not least, unrealistic patient expectations and/or the inability of the patient to understand the reasoning for the proposed intervention are contraindications for repairing a tympanic membrane through myringoplasty.

Relative

Eustachian tube dysfunction increases the chances of failure of myringoplasty. Myringoplasty in the only hearing ear should be evaluated carefully, and the potentially small risk of sensorineural hearing loss should be outweighed by the benefits of the operation.

Such an example would be the presence of severe atelectasis, which has led to ossicular erosion, or atelectasis with changes indicating progression to cholesteatoma. Every attempt should be made to control allergies manifested by upper respiratory symptomatology that will increase the incidence of failure of myringoplasty.

Fate of tympanic membrane grafts:[4]

Histologically tympanic membrane grafts become lined by squamous epithelium on the ear canal side and the middle ear mucosa on the tympanic cavity side. The graft itself becomes the middle or connective tissue portion of the reconstructed drum, but the orderly arrangement of concentric and radial collagen fibres as seen in the normal drum is not reconstituted in the graft.

MYRINGOPLASTY:

The term myringoplasty is reserved for the simple repair of a tympanic membrane perforation in which no ossicular reconstruction is involved. Temporalis fascia is the graft material of choice, although perichondrium obtained from the tragus produces the same success rates; however, perichondrium is not transparent and hinders future examination of the middle ear. Two basic grafting techniques have emerged, referred to as the overlay and under surface (or medial onlay) techniques.

PATIENT SELECTION:

Regardless of the grafting technique chosen, the preoperative evaluation and management of the patient with a tympanic membrane perforation remain the same. A proper history with sufficient detail as it relates to the tympanic membrane perforation is necessary as is a thorough examination of the ear in question under the examining microscope. A complete head and neck examination is essential in identifying risk factors for failure of the proposed myringoplasty. The record should document the findings, preferably diagramming the perforation in question; current technology enables the physician to obtain a high-quality photograph of the otoscopic findings. All patients should undergo pure-tone air and bone conduction audiometric testing along with speech discrimination evaluation. Tuning fork tests should be done on all patients to confirm the audiologic findings. If there is disagreement between the tuning fork examination and the audiogram, then the latter should be repeated. High-resolution computed tomographic (CT) scanning of the temporal bone is not indicated unless there is a suspicion of underlying pathology or separate indicators from the problem at hand such as revision surgery in association with chronic otorrhea. The patient is counselled preoperatively about the nature of the problem, the proposed treatment, alternative therapies, expected outcome, and potential complications. It is helpful to provide written explanations and instructions discussing pre- and postoperative care of the ear. Videotaped discussions of the proposed procedure are also useful.

The following factors must be considered and dealt with preoperatively.

Eustachian Tube Function:[25]

Assessing the function of the eustachian tube is difficult. Conflicting evidence exists in the literature as to the importance of eustachian tube function for the success of tympanic membrane repair, reflecting the inaccuracy of the methods available to assess the function of the eustachian tube. From a practical point of view, one of the most useful indications of proper Eustachian tube function is a normal contralateral ear. Bilateral pathology is associated with decreased success of surgical intervention, especially in children. Although a functioning eustachian tube is important to the success of the operation, a lack of eustachian tube function should not preclude surgical intervention. In fact, eustachian tube function may improve once the infection is removed and the middle ear space reconstructed through normalization of the mucosal inflammation seen in the presence of a perforation.

Control of Infection

Eradication or control of active infection in the ear under question is crucial. Repeat visits for proper aural toilet and monitoring of improvement in otorrhea should be instituted prior to any consideration of surgery. The patient is instructed to irrigate the ear three times a day with a sterile 1.5% acetic acid solution using a small rubber bulb ear syringe. This procedure allows purulent material to be removed from the middle ear and external canal and restores a more physiologic pH. It is important that the solution be used at body temperature to avoid caloric stimulation of the labyrinth. Following acetic acid irrigation, three drops of an antibiotic otic solution are instilled into the ear. Depending on the severity of the infection, intra venous and oral antibiotics may also be prescribed. The fluid from draining ears is not routinely cultured because the majority will respond to local care. If the ear continues to drain despite aggressive medical treatment, culture and sensitivity testing is performed and the antibiotic regimen adjusted appropriately. The majority of patients will respond to this treatment. If treatment fails, consideration should be given to other factors such as patient compliance, mastoid involvement, severe allergies, and/or incomplete treatment of the offending organism(s).

Perioperative Antibiotics[26]

In the absence of signs of active infection (purulent otorrhea), the perioperative administration of systemic antibiotics does not influence the results of myringoplasty.[26] Furthermore, perioperative antibiotics do not prevent the emergence of bacterial pathogens in the postoperative period. Similarly, the presence of no purulent otorrhea preoperatively does not indicate the presence of pathogenic bacterial flora in the middle ear and external auditory canal.

Control of Allergies and Rhinosinusitis:[27]

Every attempt is made to identify and treat coexistent inhalant allergies and sinus disease prior to surgery. The status of the upper respiratory tract directly influences eustachian tube function and therefore the eventual outcome of surgery. Therefore, a trial of antihistamines and/or nasal corticosteroid sprays may be indicated empirically based on the history and examination. If there is a strong history of allergies, skin testing with targeted desensitization should be considered.

Age of Patient:

The success of tympanic membrane repair in the paediatric age group has been reported from as low as 35% to as high as 93%. The consensus holds that myringoplasty in the paediatric age group has a lower success rate than in the adult age group. The reasons for this discrepancy are not clear but may be related to the higher incidence of otitis media and its predisposing factors in children. In children, it is best to avoid elective surgery for myringoplasty between the ages of 4 and 7 years because of the risk of otitis media and from a psychological point of view. At age 8 years and thereafter, the child should participate in the decision process for such elective surgery.

Status of Contralateral Ear:

If the ear under question is the only hearing ear, no attempt should be made to repair a tympanic membrane perforation. A small but real risk of sensorineural hearing loss does exist with myringoplasty. The rate of such hearing loss has been reported to range from 0.1 to 2%.68 often the contralateral ear may be involved by similar pathology. The choice of which ear to repair is then dependent on hearing status—the worse hearing ear should be operated first. An exception to this rule is a pathologic condition in a better hearing contralateral ear that threatens hearing or health such as cholesteatoma, active infection such as mastoiditis, or significant atelectasis with likely progression to cholesteatoma or ossicular chain erosion.

Hearing Status/Need for Hearing Aids:

If there are bilateral perforations, with significant conductive hearing loss in the absence of otorrhea, hearing aid fitting may be preferable for children under the age of 8 years. If otorrhea is provoked by hearing aid use in this situation, the worse hearing ear should be repaired first. A wet ear in and of itself is not a contraindication to myringoplasty, although purulent otorrhea is a contraindication. A wet ear should not be an absolute contraindication for myringoplasty, provided that factors such as allergies, eustachian tube function, and superinfection have been controlled. In selected patients, a mastoidectomy may be considered as an adjunct to the myringoplasty that can improve the success rate.

HISTORY OF MYRINGOPLASTY:

From the seventeenth to the nineteenth centuries, several attempts at closing tympanic membrane perforations using prosthetic materials were made. In 1878 Berthhold devised the term myringoplasty. [1, 3, 28] But the surgical repair of the tympanic membrane was first attempted by Banzer in 1640.[1,28]

The use of cauterizing agents to promote healing of tympanic membrane perforations was introduced by Roosa in 1876,[28] who used the application of silver nitrate to the rim of a perforation; the use of trichloroacetic acid was first advocated in 1895. It was not until Joynt combined the cautery and paper patch techniques that closure results improved, forming the basis of the modern-day use of the paper patch technique as popularized by Derlacki.

In 1952 Wullstein formally announced the technique of closing perforations with a split-thickness skin graft. [2, 3] Only a year later, Zollner described his experiences with a similar graft. At the same time, Wullstein and Zollner introduced the use of the operating microscope, significantly enhancing surgical results by improving the accuracy of the technique. [2]

Problems with skin grafts as the closure material for tympanic membrane perforations soon became apparent, and in 1956, Zollner first used fascia lata to close perforations. In 1958, Heermann began to use temporalis fascia[3]. In 1960, Shea described the closure of tympanic membrane perforations using a vein graft.[3] The advantages of connective tissue over skin as a grafting material were confirmed by the higher percentage of successful closures; however, skin grafting of perforations was not completely abandoned. Meatal skin, which lacks glands and is elevated with the underlying periosteum, has distinct advantages over skin grafts, both full and split thickness,[2, 3]from other areas of the body. It has continued to be used in selective instances. In the 1960s and 1970s, homograft (cadaveric) materials, including tympanic membrane, dura, and pericardium, among others, were used with varying success. None of these materials gained universal acceptance and today pose a problem because of the potential for transmitting disease (eg, Jakob-Creutzfeldt disease and HIV infection). Temporalis fascia continues to be the material of choice for reconstruction of the tympanic membrane.

Role of endoscope in ear surgeries:[5, 6]

Rigid Hopkins rod endoscopes and fiberoptic endoscopes are both available for use in temporal bone surgery. Generally, the rigid endoscopes are preferred because of their superior resolution. Newer generation rigid endoscopes, using gradient index of refraction lenses, are becoming ever smaller, and are closing the gap with fiber technology. Charge-coupled device (CCD) camera microchips are now so small that they can be placed on the end of larger endoscopic instruments, eliminating the need for fiberoptic or long-lens systems entirely. [5, 6] As CCD chips become more miniaturized, they have the potential to further revolutionize the capabilities of endoscopes.

Endoscopic images have the disadvantage of spherical distortion ("fisheye views") and cannot provide the three-dimensional view afforded with the binocular operating microscope. Endoscopic magnification increases steeply as an object comes into close proximity to the lens and can approach the powers achieved with the operating microscope. Endoscopic surgeons learn to compensate for the variable magnification and two dimensional views by watching how a structure and its surroundings change as the endoscope is moved in and out of proximity to it. The three-dimensionality of an image is re-created by these changes with endoscope motion. Endoscopes intended for introduction through the tympanic membrane must be 1.9 mm in diameter or less. Operating room exposures permit the use of larger endoscopes, such as 2.7 to 4.0 mm, which are preferred since they yield larger images with improved brightness and clarity. Endoscopes typically have 0-, 30-, and 70-degree view angles. Endoscopic illumination is provided by a halogen or xenon fiberoptic light source, generally using 150 to 300 watts. Images may be viewed directly through the endoscope lens, or, more commonly, a CCD camera is attached to the endoscope lens to deliver the images to a monitor. Computer interfaces, digital or video recording devices, and printing systems are optional.

ENDOSCOPIC TYMPANOPLASTY[5, 6]

Anterior, marginal tympanic membrane perforations are frequently repaired using a postauricular approach to maximize exposure. The visualization of far anterior perforations may be especially difficult, and the anterior margin may be completely hidden from direct view behind a prominent anterior canal bony overhang. Anterior perforations may be managed through a transcanal approach, using the endoscope to visualize the anterior margin. When the anterior margin is very narrow, lying quite close to the anterior canal and raising some question as to whether an underlay graft has sufficient contact to hold to the anterior drum remnant, an argon laser may be used to “spot weld” the graft in place. The fiber delivered laser is convenient as the tip may be bent to accommodate the anterior bony overhang. A line-of- sight laser, such as a CO2 laser, would not be useful in these circumstances.

CLASSIFICATION:

1. Onlay technique.
2. Underlay technique.

1. ONLAY TECHNIQUE:[29, 30]

In this technique graft is placed beneath the outer squamous (skin layer) of the tympanic membrane. The procedure is difficult to master because peeling only outer squamous layer of the ear drum is not easy. After that graft is placed over the perforation.

2. UNDERLAY TECHNIQUE:[31]

In this technique tympanomeatal flap is elevated along with fibrous annulus and remnant tympanic membrane and the graft is placed medial to the drum remnant or fibrous annulus rather than top of it. It is relatively easy procedure.

MERITS& DEMERITS OF THE TECHNIQUES:

MERITS OF UNDERLAY TECHNIQUE:[31]

1. Middle ear can be inspected for the disease.
2. Success rate is high.
3. Comparatively easy procedure.

DEMERITS:

1. Middle ear space may become obliterated.
2. Graft medialisation
3. Anteriorly, the graft has loose contact with the remnant ear drum leading to anterior perforation.

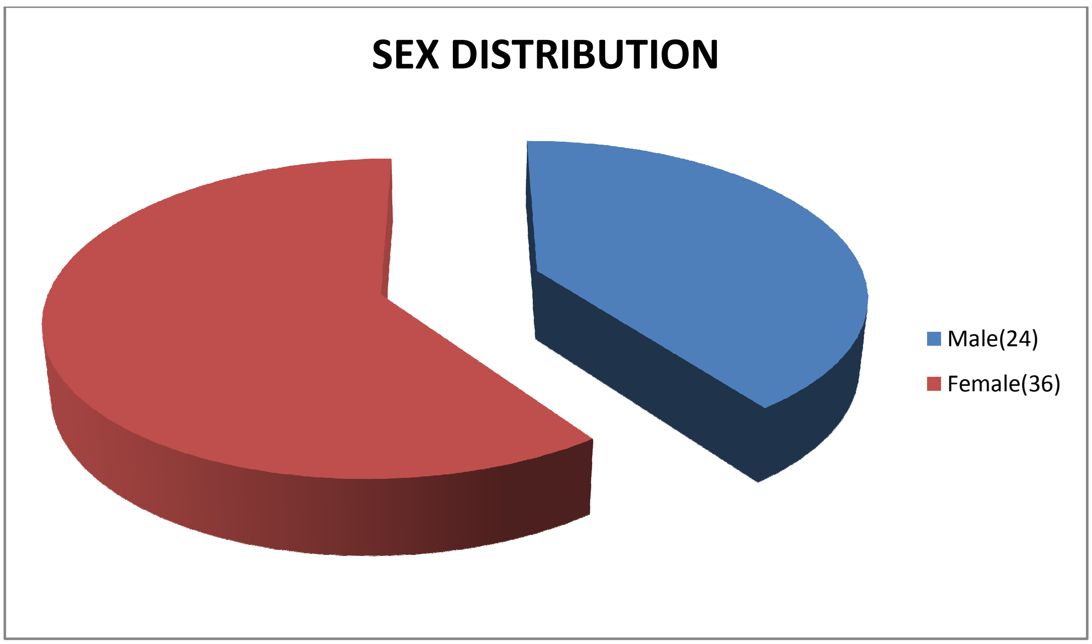
DEMERITS OF OVERLAY TECHNIQUE:

1. Anterior blunting.
2. Formation of Epithelial pearl
3. Graft lateralization
4. Middle ear is not inspected.
5. Difficult technique to master.

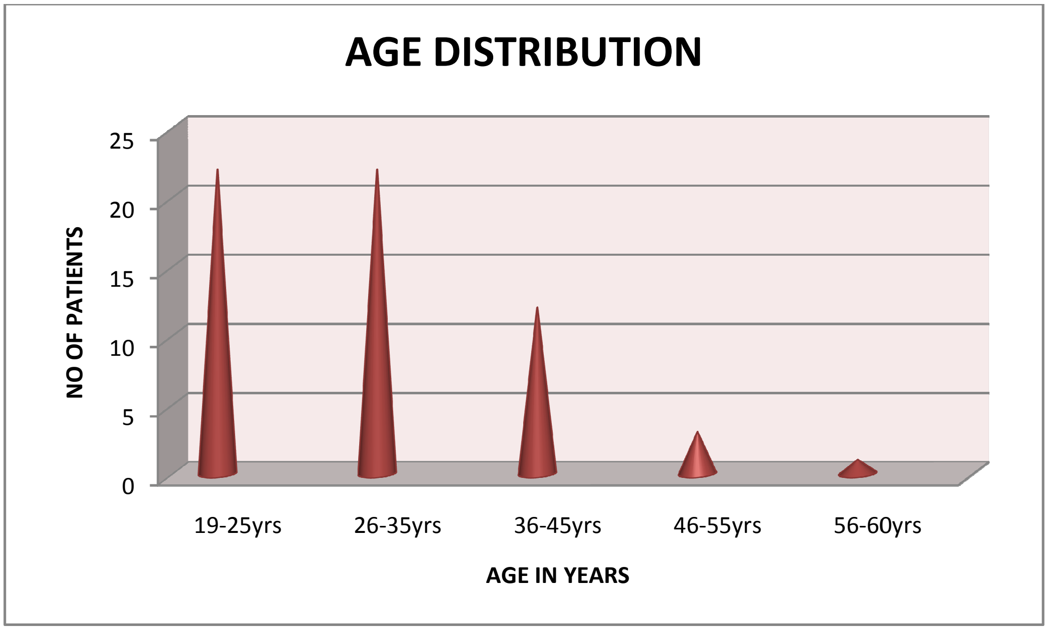
RESULTS AND OBSERVATION

60patients participated in this study. These patients came to our department between the periods from February 2001 to September 2012. All patients were followed up for at least 3 months.

Of the 60 patients, 24 were males and 36 were females.



We operated patients between 18 to 60 years of age and included for this study. Age distribution is charted below.



For better understanding of this study, each group was subdivided into 4 subgroups.

Subgroup 1 - patients having anterior quadrant perforation.

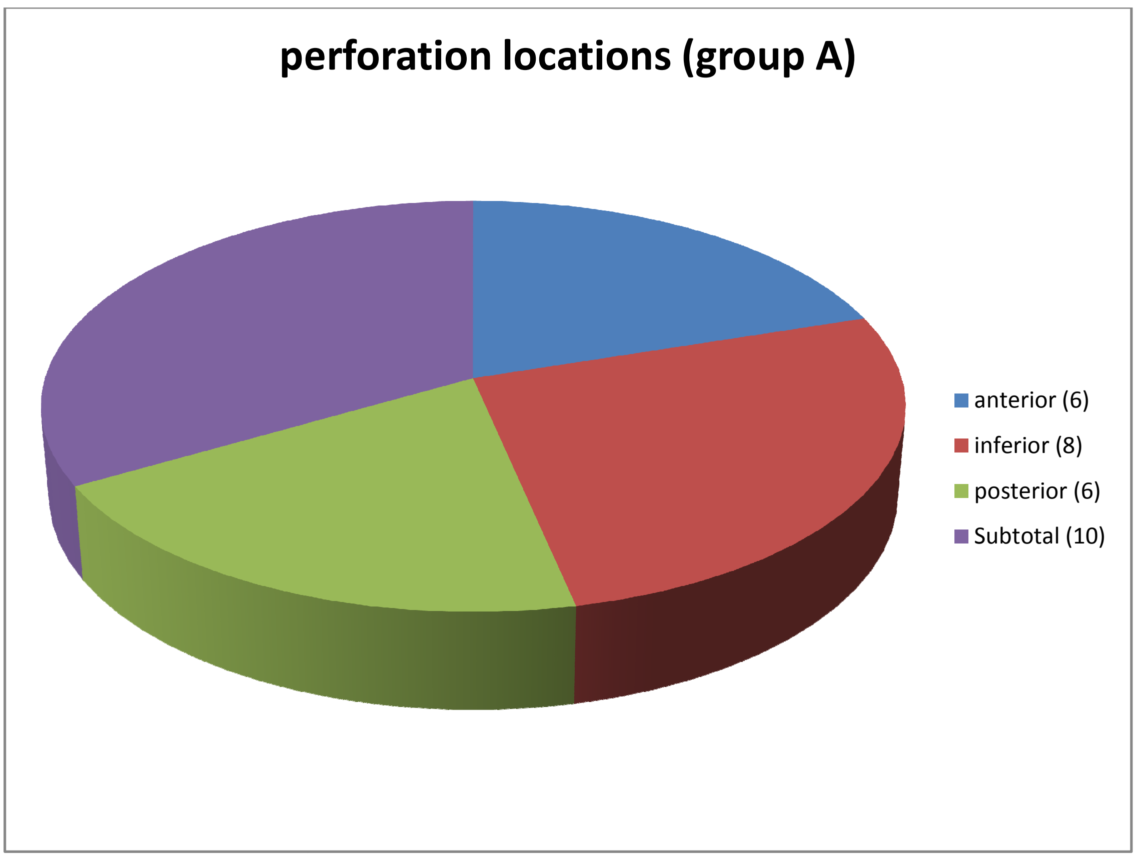
Subgroup 2 - patients having posterior quadrant perforation.

Subgroup 3 – patients having inferior quadrant perforation.

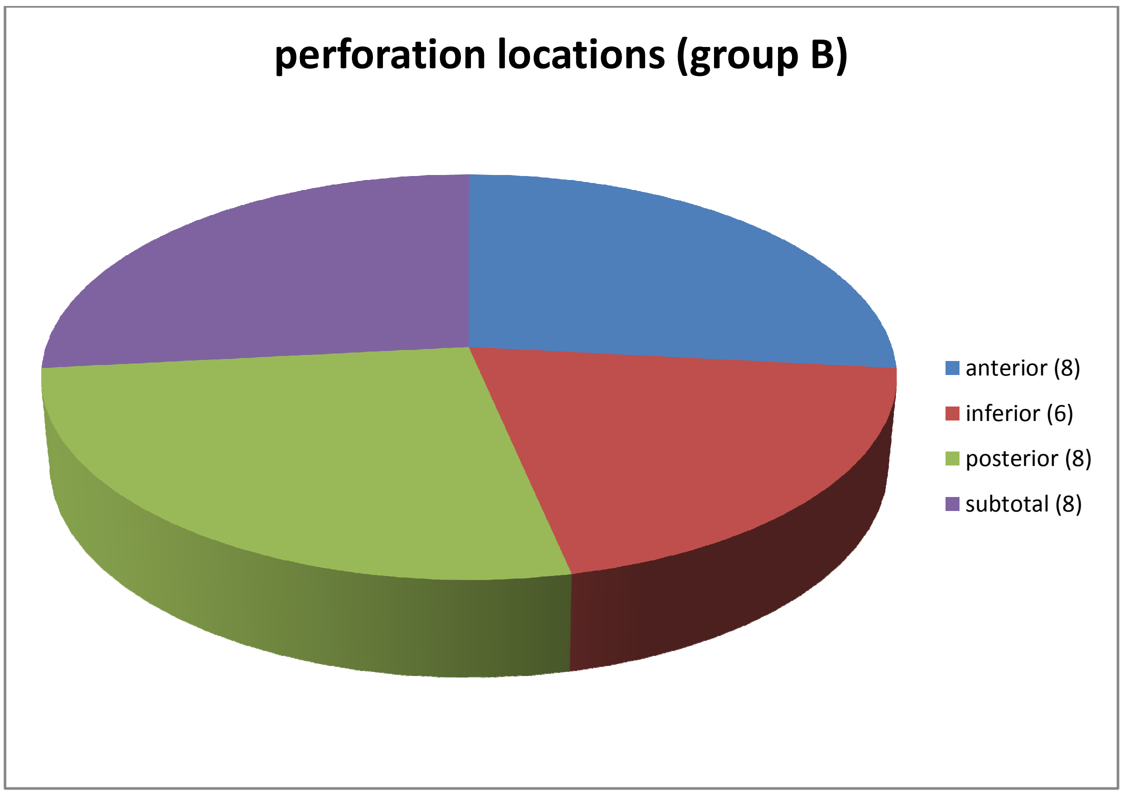
Subgroup 4 – patients having subtotal perforation.

Each subgroup is compared in terms of graft take up after 6 weeks and hearing outcome after 12 weeks, so that an appropriate technique can be selected for a particular perforation.

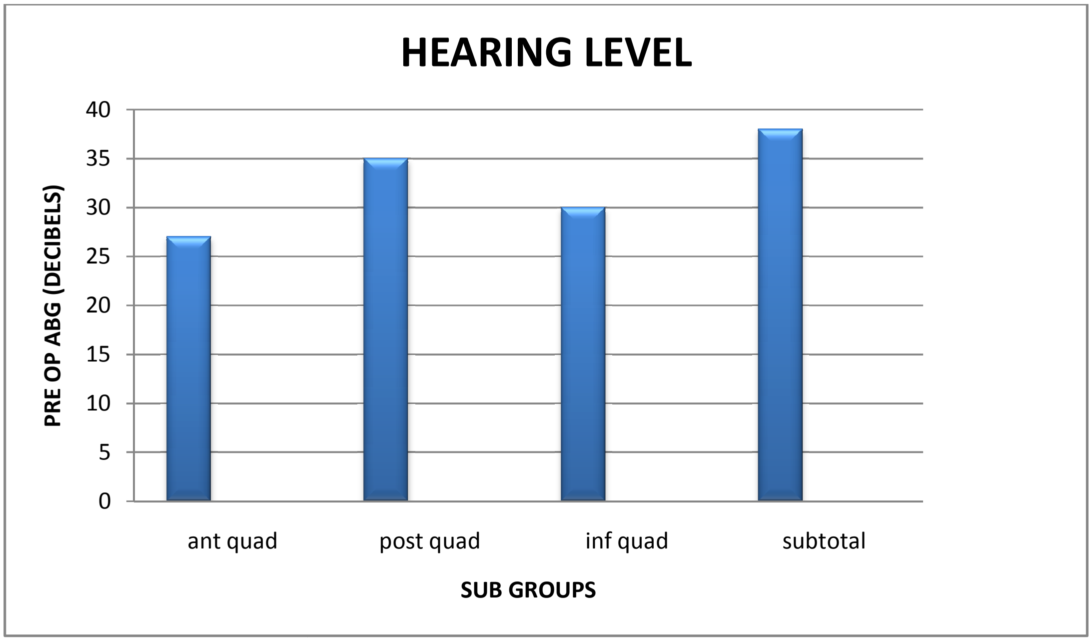
In group A, 6 patients had anterior quadrant perforation. 6 patients had posterior quadrant perforation. 8 patients had inferior quadrant perforation and 10 patients had subtotal perforation. The following pie chart represents these values.



In group B, 8 patients had anterior quadrant perforation. 6 patients had posterior quadrant perforation, 8 patients had inferior quadrant perforation and 8 patients had subtotal perforation. The following pie chart represents these values.



Air Bone gap was calculated pre and post operatively and hearing benefit was discussed. Average pre-operative air bone gap for anterior quadrant perforation was 27 decibel. For posterior quadrant perforation it was 35 decibel. For inferior quadrant perforation it was 30decibels and for subtotal perforation 37 decibels.



Overall graft success rate in this study- 83%

Graft success rate in group A - 90%

Graft success rate in group B - 75%

In group A, of the 6 patients with anterior quadrant perforation, all 6 patients showed intact graft at the end of 6 weeks. In group B, of the 8 patients with anterior quadrant perforation, 5 patients showed intact graft at the end of 6 weeks and 3 patients showed remnant anterior quadrant perforation. We will apply chi square test to calculate the significance.

Anterior perforations	**Group A**	**Group B**	
Graft taken up	**6**	**5**	**P value:0.3**
Graft failure	**0**	**3**	
Total	**6**	**8**	

Chi square test p1=6 p2=5 n1=0 n1=3

Chi sq (x^2)=1.0694Degree of freedom=1 p=0.3011.

P value is more than 0.05. So this is not statistically significant.

Among posterior quadrant perforations in group A, 5 patients had intact graft at the end of 6 weeks. One graft got rejected because of post-operative wound infection. In group B, all 6 patients showed intact graft at the end of 6 weeks.

Posterior perforations	**Group A**	**Group B**	
Graft taken up	**5**	**6**	**P value: 1**
Graft failure	**1**	**0**	
Total	**6**	**6**	

Chi square test p1=5 p2=6 n1=1 n1=0

Chi sq. (x^2)=0 Degree of freedom =1 p=1.

P value is absolutely insignificant.

Among inferior quadrant perforations, 7 patients showed intact graft and 1 patient showed residual perforation at the end of 6 weeks in group A. In group B, 6 patients had intact graft and 2 patients showed residual perforation at the end of 6 weeks.

inferior perforations	**Group A**	**Group B**	
Graft taken up	**7**	**6**	
Graft failure	**1**	**2**	**P value: 1**
Total	**8**	**8**	

Chi square test p1=7 p2=6 n1=1 n1=2

Chi sq (x^2)=0 Degree of freedom =1 p=1.

Statistically it is absolutely insignificant.

In subgroup 4, patients with subtotal perforation, 8 patients in group A showed intact graft and 1 patient had residual anterior perforation. In group B, 4 patients showed intact graft and 3 patients had residual perforation.

Subtotal perforations	**Group A**	**Group B**	
Graft taken up	**9**	**5**	**P value: 0.4**
Graft failure	**1**	**3**	
Total	**10**	**8**	

Chi square test p1=9   p2=5   n1=1   n1=3

Chi sq (x^2)=0.679   Degree of freedom =1   p=0.4099.

Pvalue is not below 0.05. So statistically it is insignificant.

For easy understanding hearing results were compared between 2 divisions. Post-operative air bone gap less than 20 decibel and more than 20 decibel.

Regarding hearing outcome in patients with anterior quadrant perforation all 6 patients of group A had less than 20decibel air bone gap post operatively. In group B, 5 patient had less than 20 decibel air bone gap and 3 patients had more than 20 decibel air bone gap. To know the significance we applied chi square test.

Anterior perforations	Group A	Group B	
Post op A-B gap <20 decibels	6	5	P value: 0.3
Post op A-B gap >20 decibels	0	3	
Total	6	8	

Chi square test p1=6 p2=5 n1=0 n1=3

Chi sq (x^2)=1.0694Degree of freedom=1 p=0.3011.

p value is more than 0.05 so it is statistically insignificant.

In the same way chi square test was applied for posterior quadrant perforations, inferior quadrant perforations and for subtotal perforations and P value showed insignificant result.

Posterior perforations	Group A	Group B	
Post op A-B gap <20 decibels	5	5	P value: 1
Post op A-B gap >20 decibels	1	1	
Total	6	6	

Chi square test p1=5 p2=5 n1=1 n1=1

Chi sq (x^2)=0.6Degree of freedom=1 p=0.4386.

Inferior perforations	**Group A**	**Group B**	
Post op A-B gap <20 decibels	**7**	**6**	
Post op A-B gap >20 decibels	**1**	**2**	**P value: 1**
Total	**8**	**8**	

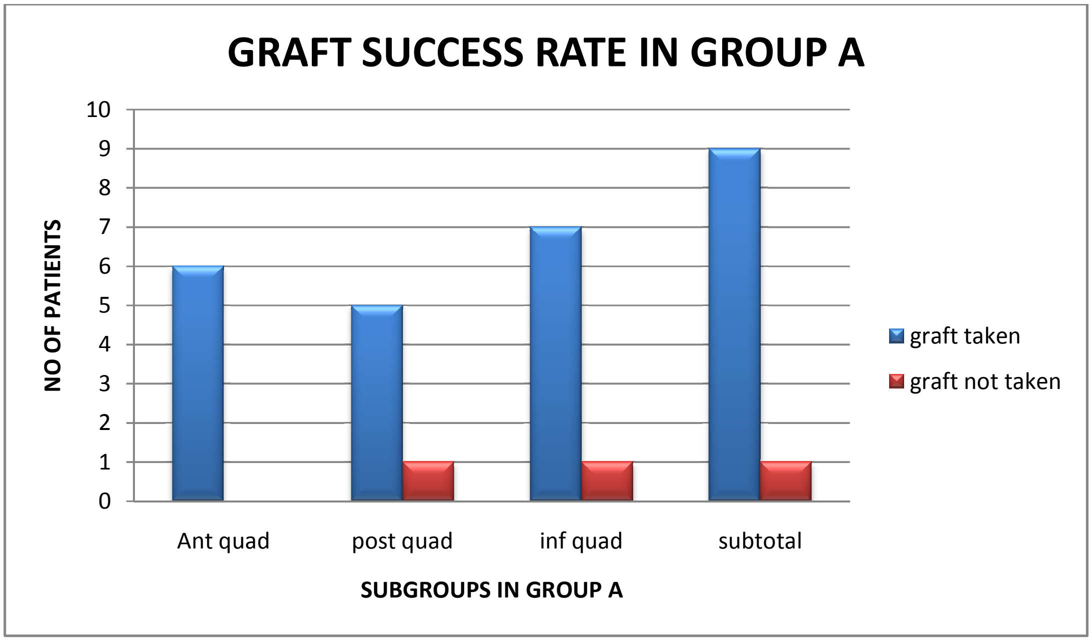
Chi square test p1=7 p2=6 n1=1 n1=2

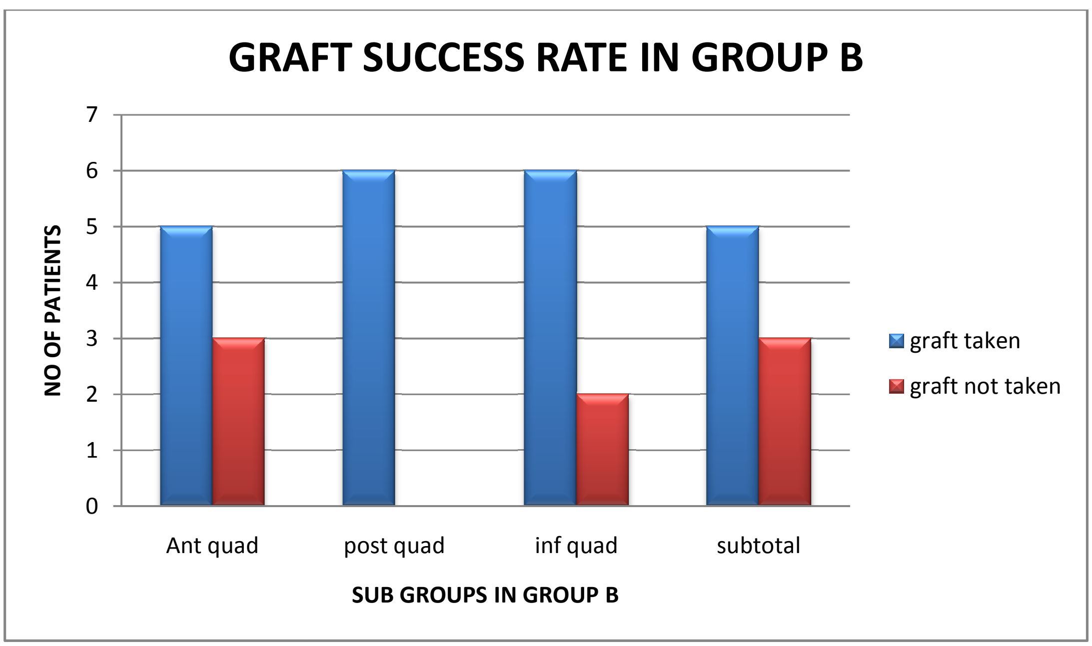
Chi sq (x^2)=0Degree of freedom=1 p=1.

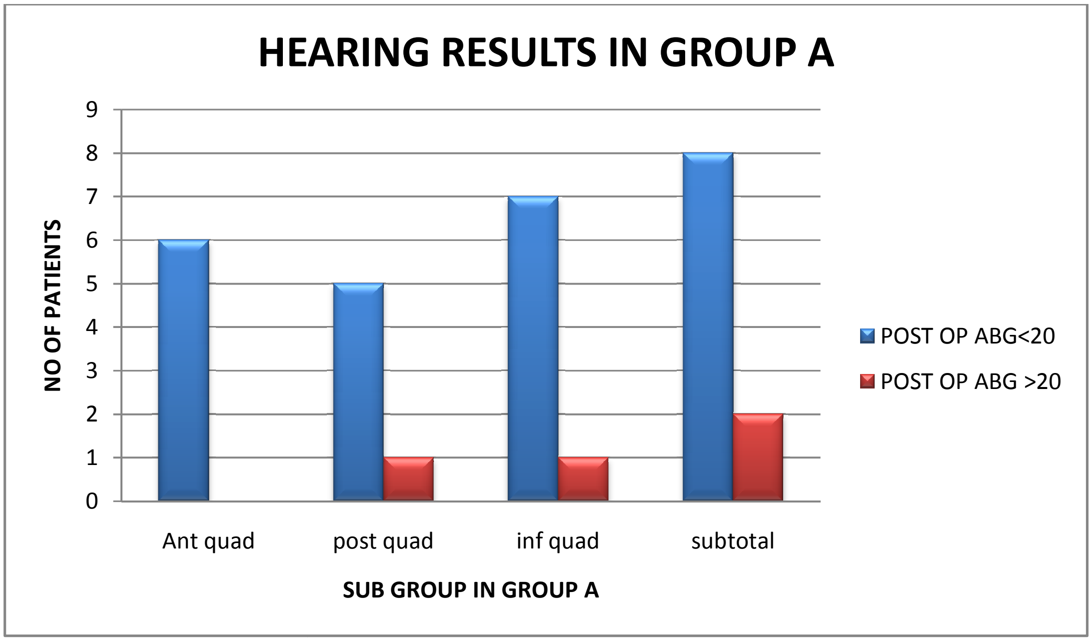
Subtotal perforations	**Group A**	**Group B**	
Post op A-B gap <20 decibels	**8**	**5**	
Post op A-B gap >20 decibels	**2**	**3**	**P value: 0.7**
Total	**10**	**8**	

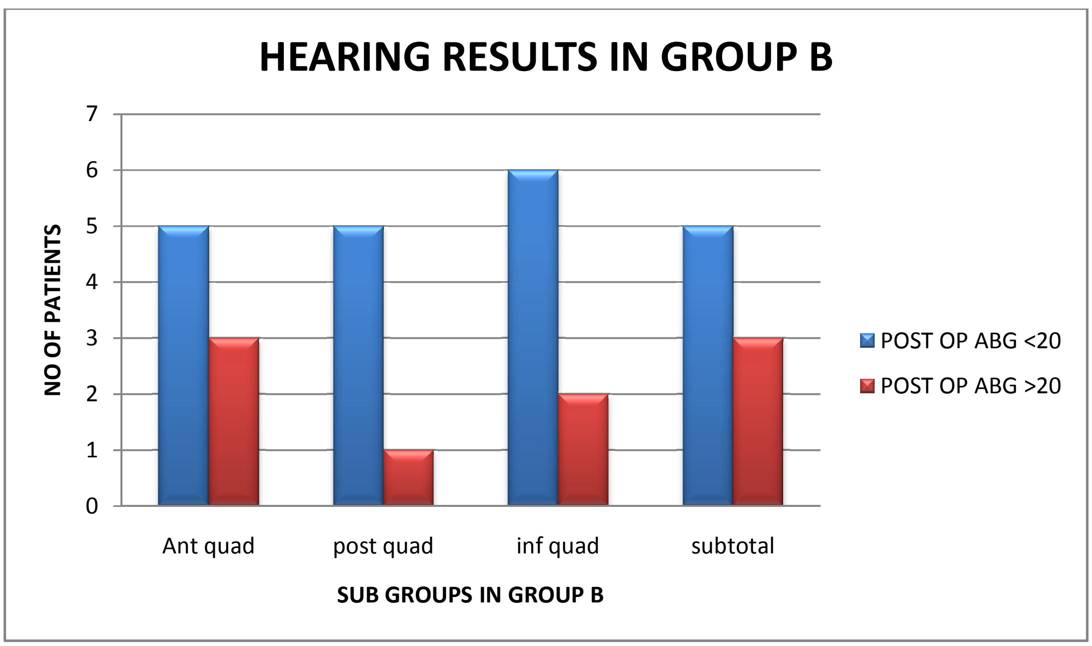
Chi square test p1=8 p2=5 n1=2 n1=3

Chi sq (x^2)=0.0865Degree of freedom=1 P=0.7686.


GRAFT SUCCESS RATE IN GROUP A
NO OF PATIENTS
10
9
8
7
6
5
4
3
2
1
0
Ant quad
post quad
inf quad
subtotal
SUBGROUPS IN GROUP A
graft taken
graft not taken


GRAFT SUCCESS RATE IN GROUP B
NO OF PATIENTS
7
6
5
4
3
2
1
0
Ant quad
post quad
inf quad
subtotal
SUB GROUPS IN GROUP B
graft taken
graft not taken


HEARING RESULTS IN GROUP A
NO OF PATIENTS
0
1
2
3
4
5
6
7
8
9
Ant quad
post quad
inf quad
subtotal
SUB GROUP IN GROUP A
POST OP ABG<20
POST OP ABG >20


HEARING RESULTS IN GROUP B
NO OF PATIENTS
0
1
2
3
4
5
6
7
Ant quad
post quad
inf quad
subtotal
SUB GROUPS IN GROUP B
POST OP ABG <20
POST OP ABG >20

DISCUSSION

Surgical repair of the ear drum perforations located anterior to the handle of malleus can present a problem. [10] The lack of anterior support for the graft frequently leads to graft failure if classical underlay technique is performed. [10]

To overcome this problem Sheehy and Anderson reported Onlay myringoplasty in their study series in 1980.[29, 30] Following them many studies were conducted on Onlay technique. But lateraliation of the graft is a common problem in this technique and the procedure itself is difficult to master. To overcome these pitfalls many modifications of classical underlay myringoplasty have been emerging.

Sharp, Terzis, Robinson reported their experience with Kerr flap to repair anterior and subtotal perforations.[32] Abolhassan et al reported mucosal pocket myringoplasty, a modification of classical underlay technique. [33]

The technique of myringoplasty “underlay technique graft placed lateral to the handle of malleus” was reported by Stage J, Bak – piedersen K in 1992. They repaired 39 tympanic membrane perforations with predominantly large or anterior pars tensaperforations.[10, 9.] They placed the graft lateral to the handle of malleus. After a median observation time of 20 months one ear was found to have a small reperforation. All ears they operated have normal tympanomeatal angles. Analysis of hearing showed good hearing improvement and no adverse effects were attributable to conventional underlay technique in ears with perforation involving the area anterior to the handle of malleus.

Shrestha, Sinha reported their study in 2006. They used temporalis fascia as grafting material and studied hearing outcomes of underlay technique. They reported 49 cases of underlay myringoplasty and in one case modified underlay technique was performed where graft placed lateral to the handle of malleus for the patient with central malleolar perforation with tip of malleus touching the promontory. Post-operative hearing improvement was 18 decibels in that patient at 10^{th} week.[9]

In the present study 2 groups are compared. Group A consists of 30 patients operated with modified underlay technique. In them, graft was placed over the handle of malleus. Group B consists of 30 patients operated with classical underlay technique.

Overall success rate in group A is 90%. Whereas overall success rate in group B is 75%. However there is no statistically significant difference between the two groups.

According to the site of perforation, for anterior perforations group A patients showed 100% graft take up rate. Graft take up rate in group B is 63%.

For posterior perforations success rate in group A was 84%. Whereas in group B, it was 100%. For inferior perforations success rate in group A is 88% whereas in group B, it is 75%. For subtotal perforations success rate in group A was 90% whereas in group B, it was 63%.

For better understanding, graft take up rates are tabulated below:

	Group A (%)	Group B (%)
Anterior perforations	100	63
Posterior perforations	84	100
Inferior perforations	88	75
Subtotal perforations	90	63

But there is no statistically significant difference between these 2 groups in any type of perforations. Chi square test gives P value 1 for anterior and inferior perforations. It states that absolutely there is no significant difference between these 2 groups. But P value for anterior quadrant perforation was 0.3 and for subtotal perforation was 0.4. These two values are less than 1. So even though these values are not statistically significant values of anterior and inferior quadrant perforations shows some significance than posterior and inferior quadrant perforations.

So here we can come to one conclusion. That is placing graft lateral to the handle of malleus is a good alternative technique to classical underlay technique for anterior and subtotal perforations.

Regarding hearing, 87% of patients in group A have less than 20 decibel Air bone gap post operatively. 70% of patients in group B showed less than 20 decibel

Hearing success rate of each subgroup is tabulated below for better understanding.

	Group A (%)	Group B (%)
Anterior perforations	100	63
Posterior perforations	83	80
Inferior perforations	88	75
Subtotal perforations	90	63

P values of anterior, posterior, inferior and subtotal perforations are 0.3, 0.8, 1, and 0.7 respectively.

There is no statistically significant difference between these two groups in any type of perforations.

CONCLUSION

- Modified underlay technique, placing the graft lateral to the handle of malleus is a good alternative technique to classical underlay myringoplasty for anterior and subtotal perforations.

- There is no statistically significant difference in hearing outcome between these two groups.

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PROFORMA

A COMPARATIVE STUDYBETWEEN MODIFIED UNDERLAY MYRINGOPLASTY WITH GRAFT OVER THE HANDLE OF MALLEUS AND CLASSICAL UNDERLAY TECHNIQUE WITH GRAFT UNDER THE HANDLE OF MALLEUS

Name :

Age/sex:

Occupation:

OP/IP NO:

Address :

DOA:

DOS:

DOD:

- Chief complaints:
- Ear discharge

duration		
Color		
Smell		
Amount		
Nature		
Agg factors		
Relieving fac		

- Hard of hearing:

	right	**Left**
Onset		
duration		

- h/o earache:
- h/o vertigo:
- h/o tinnitus:

NASAL COMPLAINTS:

- H/O discharge:
- H/O nasal obstruction:
- H/O post nasal discharge:
- H/O smell:

THROAT COMPLAINTS:

- H/O snorimg
- H/O mouth beathing

PAST HISTORY:

MEDICAL HISTORY:

- *H/O Allergy:*
- *H/O Exposure to noise pollution:*

SURGICAL HISTORY:

- *H/O surgery in ear, nose, throat.*

FAMILY HISTORY:

- *H/O hard of hearing in family members.*

- GENERAL EXAMINATION:

PALLOR	ICTERUS	CLUBBING	CYANOSIS	PEDAL EDEMA	GLNE

- EXAMINATION OF THE EAR:

	PINNA	PRE AURICULAR REGION	POST AURICULAR REGION	EAC
RIGHT				
LEFT				

- **TYMPANIC MEMBRANE: PERFORATION**

SIZE	SHAPE	MARGINS	LOCATION	MID EAR

- **OTHER FINDINGS:**

	RIGHT	**LEFT**
GRANULATION		
DISCHARGE		
RETRACTION		
CH.FLAKES		

	RIGHT	**LEFT**
OSSICLES		
COLOR OF TM		
TYMPANOSCLEROSIS		

- **TUNING FORK TESTS:**

	RIGHT	**LEFT**
RINNE'S 256 512 1024		
WEBER'S		
ABC		

- FISTULA TEST:
- VALSALVA'S MANEOVOUR:

EXAMINATION OF NOSE:

	EXTERNAL	**SEPTUM**	**TURBINATE**	**MEATUS**	**MUCOSA**
RIGHT					
LEFT					

ORAL CAVITY:

OROPHARYNX:

THROAT:

POST NASAL EXAMINATION:

IDL FINDINGS:

INVESTIGATIONS:

- CBC, RFT, Blood grouping and typing, urine routine
- HIV – ELISA
- CXR,ECG
- Pure tone audiometry
- X ray mastiod
- Otoendoscopy
- Aural swab
- Diagnostic nasal endoscopy
- Procedure:
- Anaesthesia:
- Approach:
- EOT findings:

TYMPANIC MEMBRANE: PERFORATION

SIZE	SHAPE	MARGINS	LOCATION	MIDDLAE EAR MUCOSA

- Ossicular status:
- Eustachian tube orifice:
- Cholesteatoma:

	complaints	Otoendoscopy	PTA
VISIT 1 1 WEEK			
VISIT 2 2 WEEEKS			
VISIT 3 4 WEEKS			
VISIT 4 6 WEEKS			
VISIT 5 3 MONTHS			
VISIT 5 6 MTS TO 1 YEAR			
VISIT 6 1 YEAR			

தகவல் படிவம்

காதில் சீழ் வடியும் நோய்க்கு (Chronic Suppurative Otitis Media) இரண்டு வகையான அறுவை சிகிச்சைகள் உள்ளன. (Classical Underlay Technique and Modified Underlay Technique)

அறுவை சிகிச்சை முறை

இந்த இரண்டு அறுவை சிகிச்சைகளும் முழு மயக்கம் இல்லாமல் வலி இல்லாமல் இருக்க மருந்து கொடுத்து செய்யப்படும். இந்த இரண்டு அறுவை சிகிச்சை முறைகளும் உள்நோக்கு (Endoscope) கருவியின் துணையுடன் செய்யப்படும். இந்த இரண்டு அறுவைசிகிச்சை முறைகளில் ஒன்று நோயாளிக்கு பின்பற்றப்படும்.

காதின் செவிபறையில் உள்ள துளையினை அடைக்க சிறிய சவ்வு காதின் மேற்புறத்திலிருந்து எடுக்கப்படும்.

அறுவைசிகிச்சைக்கு பின்பு காதை சோதனை செய்ய அவ்வப்பொழுது (Follow up) நோயாளி வர நேரிடும்.

உண்டாக கூடிய இடர்கள்

அனைத்து அறுவை சிகிச்சை முறைகளுக்கும் இருப்பது போல சில எதிர்பாராத இடர்கள் ஏற்படலாம். காது கேட்கும் தன்மை குறைவதற்கு வாய்ப்பு உண்டு அறுவை சிகிச்சைக்கு பின்பும் காதில் சீழ் வடிய வாய்ப்புள்ளது.

சுய ஒப்புதல் படிவம்

ஆராய்ச்சி நிலையம் : காது, மூக்கு, தொண்டை பிரிவு
ஸ்டான்லி அரசு பொது
மருத்துவமனை மருத்துவக் கல்லூரி
சென்னை - 600 001.

பங்கு பெறுபவரின் பெயர் :

பங்கு பெறுபவரின் எண் :

மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது. என் காது நோய் பற்றிய சந்தேகங்களை கேட்கவும், அதற்கான தகுந்த விளக்கங்களை பெறவும் வாய்ப்பளிக்கப்பட்டது. என் காதில் உள்ள நோய்க்கு இரண்டு வகையான அறுவை சிகிச்சை முறைகள் உள்ளன என்பதை அறிந்தேன். இதில் ஒன்றை எனக்கு பின்பற்றவும் இந்த அறுவை சிகிச்சை முறையின் விளைவுகளை ஆய்வில் பயன்படுத்தவும் தன்னிச்சையாக சம்மதிக்கின்றேன். எக்காரணத்தினாலும் எந்த கட்டத்திலும் எந்த சட்ட சிக்கலுக்கும் உட்படாமல் இந்த ஆய்வில் இருந்து விலகிக்கொள்ளலாம் என்றும் அறிந்து கொண்டேன்.

இந்த ஆய்வின் மூலம் கிடைக்கும் தகவல்களையும் பரிசோதனை முடிவுகளையும் மருத்துவர் மேற்கொள்ளும் ஆய்வில் பயன்படுத்திக் கொள்ளவும் அதை பிரசுரிக்கவும் தேவைப்பட்டால் எனக்கு நடைபெறும் அறுவை சிகிச்சையையும் என்னையும் புகைப்படம் எடுக்கவும் நான் முழு மனதுடன் சம்மதிக்கிறேன்.

பங்கேற்பவரின் கையொப்பம்: நாள்:

கட்டை விரல் ஒப்பம்: இடம்:

பங்கேற்பவரின் பெயர் விலாசம்:

ஆய்வாளரின் கையொப்பம்: நாள்:

ஆய்வாளரின் பெயர்: இடம்:

S.NO	NAME	AGE	SEX	IP NO	ACTIVE STAGE DURATION	INACTIVE STAGE DURATION	SIZE	QUADRANT INVOLVED (%)	PRE OP AB GAP dB	TECHNIQUE	GRAFT POSITION 1 MONTH	3 MTS	6 MTS	POST OP AB GAP 3MTS dB	6 MTS dB
1	MANJU	22	F	316202	CHILDHOOD	6MTS	ANTERIOR	25%	25%	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	10	10
2	PECHIYAMMAL	48	F	70516	CHILDHOOD	9MTS	INFERIOR	30%	30	LATERAL TO MALLEUS	NOT TAKEN	NOT TAKEN	NOT TAKEN	20	20
3	ICTHIYAS	24	M	79426	CHILDHOOD	3MTS	SUBTOTAL	90%	37	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	15	15
4	SUJATHA	30	F	67040	5 YRS	3MTS	INFERIOR	25%	25	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	15	15
5	RUTH	33	F	66925	CHILDHOOD	2MTS	ANTERIOR	30%	29	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	12	12
6	MOHAMED IQBAL	20	M	5201	CHILDHOOD	2 MS	ANTERIOR	25%	27	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	12	12
7	DEVAN	29	M	74867	5 YRS	3 MTR	SUBTOTAL	90%	40	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	18	18
8	SELVI	40	F	40225	5 YRS	4 MTR	SUBTOTAL	90%	43	LATERAL TO MALLEUS	NOT TAKEN	NOT TAKEN	NOT TAKEN	10	10
9	NAGA MUTHU	48	F	10750	2 YRS	4 MTR	INFERIOR	25	35	LATERAL TO MALLEUS	NOT TAKEN	NOT TAKEN	NOT TAKEN	15	15
10	JAYA CHITRA	25	F	84429	CHILDHOOD	2 MTR	INFERIOR	25	30	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	12	12
11	KALAI ARASI	32	F	56235	CHILDHOOD	6 MTR	SUBTOTAL	90	37	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	26	26
12	AYUP	24	M	23074	CHILDHOOD	2 MTR	POSTERIOR	25	32	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	15	15
13	BASKAR	37	M	44504	CHILDHOOD	6 MTR	INFERIOR	25	30	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	8	8
14	RAMACHANDRAN	28	M	43993	5 YRS	2 MTS	POSTERIOR	25	35	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	15	15
15	BHARATHI RAJA	23	M	9662	2 YRS	6 MTR	ANTERIOR	30	29	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	15	15
16	BHARATHI	35	F	37793	CHILDHOOD	2 MTR	POSTERIOR	25	38	LATERAL TO MALLEUS	NOT TAKEN	NOT TAKEN	NOT TAKEN	35	35
17	RATHIHA	30	F	9445	CHILDHOOD	2 MTR	POSTERIOR	25	30	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	20	20
18	GOVINDHU	32	M	9088	CHILDHOOD	2 MTR	ANTERIOR	25	27	LATERAL TO MALLEUS	NOT TAKEN	NOT TAKEN	NOT TAKEN	22	22
19	GAJENDRAN	34	M	10629	CHILDHOOD	6 MTR	INFERIOR	30	32	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	18	18
20	GUNA SUNDARY	23	F	115626	CHILDHOOD	6 MTR	POSTERIOR	30	33	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	15	15
21	SASIKALA	20	F	16434	5YRS	6 MTR	ANTERIOR	25	25	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	8	8
22	VELA	27	F	21949	2 YRS	6 MTR	SUBTOTAL	90	37	LATERAL TO MALLEUS		TAKEN	TAKEN	24	24
23	MARY	32	F	25337	Y YRS	2 MTS	SUBTOTAL	90	40	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	18	18
24	LAKSHMI	25	F	105102	CHILDHOOD	2 MTS	INFERIOR	25	28	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	15	15
25	SHANTHI	27	F	80877	CHILDHOOD	2 MTS	SUBTOTAL	90	43	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	12	12
26	PRIYA	30	F	9725	CHILDHOOD	2 MTS	POSTERIOR	25	37	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	18	18
27	LATHA	38	F	27444	CHILDHOOD	6 MTS	SUBTOTAL	90	37	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	15	15
28	BALA CHANDAR	21	M	177683	CHILDHOOD	6 MTS	INFERIOR	25	30	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	18	18
29	VIVEK	31	M	177091	CHILDHOOD	6 MTS	POSTERIOR	30	35	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	15	15
30	REVATHY	36	F	171081	CHILDHOOD	4 MTS	SUBTOTAL	90	40	LATERAL TO MALLEUS	TAKEN	TAKEN	TAKEN	16	16

S.NO	NAME	AGE	SEX	IP NO	STAGE DURATION	INACTIVE STAGE DURATION	SIZE	QUADRANT INVOLVED	PRE OP AB GAP dB	TECHNIQUE	GRAFT POSITION 1 MONTH	3 MTS	6 MTS	POST OP AB GAP 3MTS dB	6 MTS dB
1	SASI	20	F	12738	CHILDHOOD	3MTS	POSTERIOR	25%	32	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	15	15
2	DUSHYANTH	21	M	10479	CHILDHOOD	6 MTS	INFERIOR	25%	26	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	18	18
3	BANUMATHY	39	F	42522	CHILDHOOD	4 MTS	ANTERIOR	25%	25	MEDIAL TO MALLUES	TAKEN	NOT TAKEN	NOT TAKEN	16	16
4	RAVI	32	M	321620	CHILDHOOD	5	INFERIOR	25%	32	MEDIAL TO MALLUES	NOT TAKEN	NOT TAKEN	NOT TAKEN	22	22
5	JENEFER	25	F	49557	5 YEARS	3	POSTERIOR	30%	38	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	18	18
6	ASIKAH MISHRA	20	M	496288	4 YEARS	2	ANTERIOR	25%	28	MEDIAL TO MALLUES	TAKEN	NOT TAKEN	NOT TAKEN	23	23
7	MEGALA	21	F	560732	CHILDHOOD	6 WKS	SUBTOTAL	90%	34	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	24	24
8	MEENATCHI	30	F	571366	5 YEARS	6 WKS	POSTERIOR	30%	34	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	15	15
9	RAGLU	38	M	36332	5 YEARS	2 MTS	ANTERIOR	30%	22	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	18	18
10	NAZREEN	22	F	45013	2 YEARS	2 MTS	SUBTOTAL	90%	40	MEDIAL TO MALLUES	NOT TAKEN	NOT TAKEN	NOT TAKEN	22	22
11	PREM KUMAR	22	M	33848	CHILDHOOD	4 MTS	ANTERIOR	25%	22	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	10	10
12	VALLI	22	F	439	CHILDHOOD	5 MTS	ANTERIOR	30%	25	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	22	22
13	SAGAYA MARY	28	F	2971	4 YEARS	6 WKS	SUBTOTAL	90%	42	MEDIAL TO MALLUES	TAKEN	NOT TAKEN	NOT TAKEN	18	18
14	KALPANA	28	F	3629	4 YEARS	6 WKS	POSTERIOR	30%	36	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	22	22
15	SURESH	20	M	579874	2 YEARS	6 WKS	SUBTOTAL	90%	32	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	15	15
16	JEYARAJ	30	M	103150	3 YRS	6 WKS	INFERIO	25%	30	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	10	10
17	PANCHASARAM	60	M	18547	5 YRS	2 MTS	POSTERIOR	30%	32	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	12	12
18	SHANKAR	48	M	20078	5 YRS	3 MTS	SUBTOTAL	90%	36	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	24	24
19	RGHUL	19	M	17111	CHILDHOOD	6 MTS	INFERIOR	30%	38	MEDIAL TO MALLUES	NOT TAKEN	NOT TAKEN	NOT TAKEN	12	12
20	KALAI RANI	45	F	20087	CHILDHOOD	4 MTS	ANTERIOR	25%	28	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	10	10
21	SARANYA	20	F	21909	CHILDHOOD	4 MTS	SUBTOTAL	30%	38	MEDIAL TO MALLUES	TAKEN	NOT TAKEN	NOT TAKEN	23	23
22	KANNIYAMMAL	45	F	20489	5 YEARS	6 WKS	ANTERIOR	30%	25	MEDIAL TO MALLUES	NOT TAKEN	NOT TAKEN	NOT TAKEN	12	12
23	MARIYA	31	F	24203	3 YRS	6 WKS	SUBTOTAL	90%	37	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	15	15
24	KOTESH MARI	24	F	25345	3 YRS	2 MTS	INFERIOR	25%	28	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	22	22
25	SALASNATHY	40	F	25661	2 YRS	2 MTS	INFERIO	30%	34	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	15	15
26	SELVI	45	F	26705	2 YRS	4 MTS	POSTERIOR	90%	39	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	18	18
27	DIVYA	27	F	37494	CHILDHOOD	4 MTS	ANTERIOR	30%	25	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	22	22
28	KAMACHI	40	F	120663	5 YRS	5 MTS	INFERIOR	30%	28	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	10	10
29	MOHANRAJ	38	M	997743	CHILDHOOD	6 WKS	SUBTOTAL	90%	35	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	28	28
30	THIRUPATHY	37	M	102621	CHILDHOOD	6 WKS	INFERIOR	20%	32	MEDIAL TO MALLUES	TAKEN	TAKEN	TAKEN	12	12

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A Dissertation on

A COMPARATIVE STUDY BETWEEN MODIFIED UNDERLAY MYRINGOPLASTY WITH GRAFT OVER THE HANDLE OF MALLEUS AND CLASSICAL UNDERLAY TECHNIQUE WITH GRAFT UNDER THE HANDLE OF MALLEUS

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THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

In partial fulfilment of the requirements

For the award of the degree of

M.S.BRANCH IV
(OTORHINOLARYNGOLOGY)

40 **GOVERNMENT STANLEY MEDICAL**

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